# A NEW CONTRIBUTION

TO THE

## HISTORY AND ETIOLOGY

OF

# SPONDYL-OLISTHESIS.

BY

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TRANSLATED BY

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# TRANSLATOR'S INTRODUCTORY NOTE.

Since Kilian, in 1853, first drew the attention of obstetricians to the spondyl-olisthetic pelvis through the specimen known as the Prague pelvis, no new light had been thrown upon the condition until Neugebauer, in 1884, propounded his views in the *Annales de Gynécologie*. Until Neugebauer had examined and described the seventeen pelves recognised as spondyl-olisthetic up to that date, the views of Rokitanski and Kilian, that the lesion originated in caries of the vertebra, were generally accepted. Neugebauer, however, demonstrated by his specimens at the Obstetrical Society in 1884 that in many cases the deformity arose from some breach of continuity, either traumatic or congenital, in the neural arch. A committee was appointed by the Obstetrical Society, consisting of Dr. Robert Barnes, Messrs. William Adams, Alban Doran, and Noble Smith. These gentlemen, after having examined the specimens and consulted thereon, reported that they agreed with Dr. Neugebauer in his views, and confirmed the accuracy of his conclusions. It is now generally accepted that this deformity in the majority of cases results from a solution of continuity across the neural arch of the fifth lumbar vertebra between its superior and inferior processes on either side. This theory is in opposition to the views formerly held, namely, that the deformity occurred from caries, rickets, osteomalacia, tuberculosis, or hydrorachis. The solution of continuity of the neural arch may, according to Neugebauer, be congenital or acquired. Neugebauer suggests that pathologists should carefully examine the pelvis in all fatal cases of injury from falling. He believes that if this is done, commencing or advanced spondyl-olisthesis will be occasionally discovered.

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Although the history of spondyl-olisthesis has quite recently been enriched by the interesting work of Swedelin in the last number of the *Archives of Gynækology,* I nevertheless am induced to publish separately some fresh clinical observations made by me since that time, as they are valuable from several points of view. Some time ago 17 cases of lumbo-sacral spondyl-olisthesis as pathological specimens and only 16 cases seen clinically were published and made known to a large circle of the profession. It now appears that two accounts published in 1875 were overlooked in the making the list of the literature of the subject, as they were accessible only to a limited number of readers: one of these was a case of spondyl-olisthetic pelvis seen during labour at Christiana, and published in the transactions of the medical society of that place; the other was a dissertation published at Friburg in 1875, in which two other cases were described by Egger. The number of clinical observations was thus increased to 19, to which I will now add 6 more; of these one was seen by Hegar in Friburg, one by Freund in Strasburg, while one at Strasburg, another at Paris, and two more at Berlin have lately come under my own observation. The total number of clinical cases, including one of Zweifel's at Erlangen yet unpublished, would therefore amount to 26.*

* In all, therefore, 43 cases of spondyl-olisthetic pelvis (including one clinical case in a man) were known up to January 1884, viz. :—

(*a*) 17 anatomical preparations: 2 each at Prague, Vienna, and Würtzburg; 1 each at Bonn, Breslau, Giessen, Halle, Liège, Moscow, Munich, Paderborn, Paris, Treves, Zurich (in 9 of these cases the subjects had been under clinical observation during life).

(*b*) 26 clinical observations: in Berlin, Friburg, and Strasburg, in each 3 cases; in

Before describing my own observations at Strasburg, Paris, and Berlin, I will give a short report of the other cases mentioned.

*Clinical Observation in Christiana.*

This case is published in the *Forhandlinger i det norske medicinske Selskab* i 1874, Christiana, 1875; contained in the journal *Norske Magazin for Lagevidenskab, Udgivet af det medicinsk Selskab i Christiana Tredie raekke.* Redigirt af Jacob Heiberg. Tjerde Bind, Christiana, 1874 (?).

Unfortunately I was unable, in spite of much trouble, to obtain the journal in question, and must therefore confine myself to the transcription of the written account brought to me from Christiana by my father on the occasion of a summer trip to Norway.

On pp. 173—200, 189—200 of the journal mentioned in the report of the meeting of the Society under the Presidency of Dr. Schönberg, on the 23rd September, 1874, the following communication is to be found: Dr. Vedeler, assistant to Professor Faye, describes a case of spondyl-olisthetic pelvis seen in his clinic in 1874. The woman, aged 28, was admitted into the hospital pregnant for the eleventh time, and in the absence of Professor Faye, and was delivered by the induction of premature labour by Dr. Vedeler and Dr. Kaiser. In the report of the meeting on the 7th October, 1874, pp. 200—213, 202—204,

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Dresden, Halle, and Prague, in each 2 cases; and 1 case in each of the following towns: Basle, Berne, Christiana, Coblenz, Erlangen, San Francisco, Leipsic, London, Petersburg, Stuttgart, and Paris.

Lastly, I learn from Professor Nicoladoni that there is an anatomical preparation at Innsbruck; and Professor Mayer, of Friburg, informs me that he has such a pelvis in his collection. Professor Mayer could not, however, find it during my stay in Friburg, as he was just in the act of occupying a newly built institution, and a large number of the preparations were still packed up on account of their removal.

The French obstetrician, Charpentier, in his comprehensive text-book of midwifery, which was published in two volumes only a few months ago, has given the total of spondyl-olisthetic, including spondylizematic pelves, as only 29 (*Traité pratique des Accouchements*. Paris, 1883, Tome ii., p. 110), although he so freely cites the foreign literature of the subject. In the section relating to this affection no reference is made to the more recent studies on the etiology of spondyl-olisthesis, even the clinical aspect of this anomaly is lightly mentioned, and the historical information from the literature is not always accurate. M. Charpentier had at the time, as he informs me, no knowledge of the more recent works on the subject of spondyl-olisthesis, and this defect will be remedied in the next edition of his work.

it is stated: Professor Schönberg said in reference to Vedeler's communication on spondyl-olisthesis that he had himself examined the woman during labour, and must confirm the diagnosis.

In a later volume of the same journal, in the proceedings of 1876 (Christiana, 1877), it is stated in the report of the meeting on March 8th, 1876, pp. 31—48, 33—41, L. Faye (p. 33) gives a description of the twelfth labour of the same woman in whom in November, 1875, he had, in conjunction with his father, F. C. Faye, induced premature labour, the child being still-born and the mother recovering. Faye declares the pelvis not to be spendyl-olisthetic, and quotes a remark made at the time by Professor Faye, to the effect that he also thought the dislocation of the vertebral column to be the result of inflammatory softening. He says further, on page 41, "Vedeler holds to his diagnosis of spondyl-olisthesis"; and finally, on pp. 41, 42, it is stated, "Schönberg points out that the fifth lumbar vertebra was dislocated downwards, and that there actually was a spondyl-olisthesis." The extracts here given are not sufficient to explain clearly the exact abnormality existing in this pelvis, and it would be desirable to get further details from Christiana.

The next two cases, seen by Hegar before 1875, are described by Egger,* but as his dissertation had only a limited circulation, I will, with the permission of Herr Hegar, give an extract from it here.

After a general and historical introduction a description is given of the

*First Clinical Case of Spondyl-olisthesis at Friburg.*

The patient was a married primipara, aged 28. Her father died from consumption in his 62nd year; her mother died in her 45th year, but no history of her mother's health or cause of her death could be obtained. Two sisters are living, and healthy. During early childhood she had no illness, but she had an attack of pituitary fever when she was four years old. She learnt to walk at the end of her first year; no signs of rickets. Her mother died when she was five years old, and she was given up to the care of strangers, and had to help in field labour,

* Siegfried Egger, *Das Spondyl-olisthetische Becken*, *Mang. Diss.* Friburg, 1875.

carry heavy loads on her head, and undertake work for which from her age and bodily strength she was still unfit.

In 1861, in her 14th year, while she was descending a small hill, carrying a heavy water-bucket on her head, she unfortunately tumbled, and falling backwards on to her sacral region the water-bucket fell on her belly. She was not able to get up again from the ground, and had to be carried home to bed. Severe pains came on in the sacral region, and about the hypogastrium, and it was only after three months had passed that she was able to make careful attempts to walk, with the aid of a stick, which she had to use for three months longer. Her body was passably bent, and from time to time the sacral pains recurred when she walked. By degrees she was able to walk upright and unaided, and from that time also the sacral pains disappeared. She does not believe that she has grown any shorter since the accident.

Menstruation came on in her 18th year, on the first and second occasions with some difficulties; it was regular, but was always preceded by slight sacral pain, which disappeared during the three days of the discharge. These pains did not interfere with her work as a domestic servant. In 1868, while lifting a heavy weight, she was suddenly seized with severe pain in the back, and was obliged to seek relief in the hospital, from which she was discharged cured, after stopping there only fourteen days. From that time she felt perfectly well; was married in 1874, and on the 10th of November of the same year after a normal pregnancy her labour commenced. On the same evening, the labour pains not having been particularly strong, the waters broke and the cord prolapsed. Next day, after version had been attempted, a dead child was delivered by the forceps. The hæmorrhage was moderate, and the placenta came away of itself.

Puerperal endometritis coming on, she remained in bed for four weeks, but was then compelled by circumstances to leave it, and immediately she was attacked with the most violent pains in the right hypogastrium. A swelling the size of an egg was found in the right parametrium, which gradually diminished under the use of moist applications, and was on a subsequent examination found to be the size of a nut. She had then no more pain, but only a feeling of tension in the hypogastrium; besides

which she was feverish, felt very weak, and as she could not receive proper attention at home, she sought assistance in the Gynæcological Hospital. The patient is 165 cm. in height, well developed as to bony structure, and moderately fat. Cheeks and mucous membranes are pale; stands and walks upright. There is a slight lordotic sinking in of the lumbar vertebra, which is more noticeable when the patient lies prone. There is no indication of hydro-rachis in the sacrum or skin of the pelvis. The spinal column can be easily felt through the abdominal walls with quite moderate pressure. The symphysis is very high, somewhat perpendicular, the inclination of the pelvis is slight, and the genitals are directed forwards. The legs are quite straight, and there are no signs of rickets in the costal cartilages. The vagina is fairly capacious; the vaginal portion lies somewhat posterior to the vertebral line; the corpus uteri enlarged, but in fair position. Both body and neck of the uterus are slightly movable. The linea terminalis is considerably elongated in its anterior segment; the pubic arch narrow. The bifurcation of the aorta cannot be felt, nor any large pulsating vessel corresponding to one of the iliac arteries. Projecting from the anterior surface of the sacrum for about the thickness of a vertebra, immediately behind the vaginal portion, is a hard prominence, which is apparently the last lumbar vertebra, this having slipped down a little to the right, so that the left half of the pelvic inlet is wider than the right. The projecting angle of dislocation is exceptionally distinct.

In the rectum one can feel the projecting dislocated vertebra as well as the projecting angle of dislocation, and also both sacro-uterine ligaments very much thickened and unyielding. The following measurements of the pelvis should be recorded here:—

| | |
|---|---|
| Diameter between the anterior superior spines | 27·0 |
| " " crests of the ilia | 31·0 |
| Distance between the trochanters | 34·0 |
| Diameter of Baudeloque | 18·5 |
| External oblique diameter, left | 23·0 |
| " " right | 24·0 |
| Distance between the tubers of the ischia | 10·0 |
| Distance from the lower margin of the pubic arch to the angle of dislocation | 12·0 |
| Distance from the lower margin of the pubic arch to the most prominent point of the lumbar vertebra within each | 9·0 |

The anamuesis with the present condition completely justify the diagnosis of spondyl-olisthesis.

In conclusion, Egger disposes of certain objections as to the existence of rickets, exostoses of the pelvis, &c., &c.

Second clinical case at Friburg (*l. c.* pp. 16, 23), Salome Haug, of Eichstellen, aged 33, single, a primipara. Her father died at the age of 67 from an attack of apoplexy. Her mother is alive and in good health, and she has eight brothers and sisters in the enjoyment of the best health; she herself was never ill when young. She learnt to walk even in her first year, and did not again leave off doing so. At the age of 14 she went into service and had to work hard.

Menstruation was normal from her 16th year. In her 19th year she was suddenly attacked by severe pains in the sacral region, without any definite cause; and noticed during her illness an increasing weakness in her lower extremities. Under careful treatment this condition improved so that she was again able to take service in an easier place, and only suffered off and on from some sacral pain; one day, however (1870), while she was lifting a pail of water she was seized suddenly with violent pain in the sacral region, and at the same time noticed a cracking noise in that locality. She broke down, and had to keep her bed for a whole three months. At every attempt to stand the pains were at first very severe, but became less so as time went on, and she gradually regained her power of standing and moving about; she remarked, however, that she was shorter than before her illness. Her poverty compelled her to go into service again, and she had very good health until May, 1872, when she conceived. The course of her pregnancy was on the whole normal; she only suffered at times from sacral pain, and was very quickly fatigued if she walked about. She went home and prepared for her lying-in, and labour pain, began on 28th January, 1873. The presentation was transverse; and on the morning of the 29th January the medical attendant made several attempts to turn under profound chloroform narcosis, unfortunately in vain. Herr Hegar was consequently called in.

He did not arrive at the place, which was at some distance, till five o'clock in the evening. The right arm protruded outside the vulva, and the uterus was most firmly contracted round the child lying across the pelvis. Several attempts at turning were

made, but in vain. The neck of the child was within easy reach, and decapitation was therefore carried out by means of long scissors. The operation was comparatively easy, as was also the delivery of the trunk depending on it. The principal difficulty, however, remained in the delivery of the head left behind in the uterus, and this difficulty was increased by the circumstance that in the decapitation the first cervical vertebra had been left attached to the head, and as a consequence the foramen magnum could not be made use of. The next thing to be done was to steady the head, and for this purpose a hook was passed into the mouth on which traction was made. The assistant, however, pulled too hard on the hook and broke the lower jaw. As the best point to lay hold of for fixing the head was lost, it was while continually rolling about laid hold of by a sharp hook carried through the roof of the orbit and the cephalotribe applied, the assistant at the same time affording support to the head by external pressure.

This attempt itself was not successful. The cephalotribe had only seized a small segment of the head and began to slip off, just as the hook lost its hold in the same way as in the attempt to fix the head by the mouth. A similar failure resulted from the same process in the other orbit; and as all means of delivering the head hitherto attempted had failed, Herr Hegar tried to reach the posterior side of the head by carrying his hand up along the sacrum, and he was able to get at a point in the squamous suture which admitted of the introduction of the scissors-shaped perforator. This passed upwards along squamous portion of the temporal bone, yet its application to the squamous suture was very difficult because the squamous part overrid the edge of the parietal bone, bevelled off in the opposite direction, and slipped away over it. Only after much trouble did the instrument pass through the suture, and at first it slipped upwards between the inner side of the skull and the dura mater, because its handle could not be sufficiently depressed. At last the membranes were perforated and the cranioclast applied; the extraction of the head was then easily accomplished. The placenta followed spontaneously.

The patient lay sick for eight weeks, feeling extremely weak, with high fever and profuse perspirations. The lochial discharge was moderate, and there were occasional pains in the abdomen.

During these eight weeks the urine was passed involuntarily; the menses had not reappeared since the labour. In this state she was admitted into the Friburg Gynækological Clinique, where the incontinence of urine, which was due to paralysis of the sphincter vesicæ, was cured, and after three months' stay in the hospital she left it fairly recovered. She still suffered from slight occasional pain in the sacral region, and had some difficulty in standing and walking, feeling quite well only in the horizontal posture.

Salome Haug was 157 cm. in height, of rather powerful, bony development, fairly covered with muscular and adipose tissue. Her extremities were not crooked; her thorax, not unduly arched, was smooth without any rachitic change. The cervical and dorsal vertebræ were regular, but there was a well-marked lordotic depression in the lumbar spine. The sacrum only moderately steep. In the lumbo-sacral region no hiatus could be felt, nor could any scar or puckering be found which would have indicated the presence of a congenital hydrorachis. The symphysis pubis was very high up. On pressure on the abdomen the lumbar vertebral column could be very easily felt, and appeared to be displaced forwards. A plumb line held against the dorsal vertebra falls into the base of the sacrum, and the distance from the deepest point of the lumbar lordosis measures 2 cm. to this line, while the distance from the same point to a line joining the most prominent point in the thoracic vertebra to the most prominent point in the sacrum, is 4·5 cm. The plumb line in the axilla falls in front of the trochanter major, and if suspended in the line of the trochanter lies posterior to the scapula. Haug, who when young used to walk bolt upright, now walks slowly, unsteadily, and with difficulty, like one with sacral paralysis. Her feet are turned rather inwards, and in standing and walking the upper part of her body is bent forwards and the knees are decidedly bent.

On examination the vagina was found moderately capacious and short, the arches of the anterior half of the pelvis convergent, and more so on the left side than on the right. The vaginal portion was short, and in normal position; from the right commissure there was a cicatricial band running to the vaginal roof. The body of the uterus was retroflexed. On the posterior wall of the pelvis there was a hard blunt projection at the level of

the first sacral vertebra, which was, however, not very distinct. The bifurcation of the aorta could not be reached, nor could any large pulsating vessel corresponding to the right or left iliac artery be felt.

Examination per rectum, though the different parts of the pelvis were easily felt, threw no fresh light on the spondyl-olisthesis; the blunt projection in the vertebral column lay directly in the middle, inclined neither to the right or left.

The following pelvic measurements should be mentioned here:—

| | |
|---|---|
| Diameter between the anterior superior spines | 25·0 |
| ,, ,, crests of the ilia | 28·5 |
| ,, ,, trochanters | 31·5 |
| Baudeloque's diameter | 19·0 |
| External oblique diameter, right | 21·0 |
| ,, ,, left | 22·5 |
| Distance between the tubers of the ischium | 9·5 |
| Diameter of cavity of the pelvis | 11·0 |
| From the lower margin of the pubic arch to an angle in the lumbar vertebræ | 10·0 |

The information derived from the history of the case, especially the fact that the patient used to walk quite straight, and that the change described afterwards took place in the way she held herself and walked, in addition to the fact that subsequent to pains in the sacral region, the patient while lifting up a heavy weight felt a distinct snap in that part of her body, the pains which followed, and the three months inability to stand or walk, all indicate a pelvic spondyl-olisthesis existing in her case.

Egger adds to the description of these two cases some remarks on the various modes of standing and walking of different women affected with spondyl-olisthetic pelvis, and says on page 23, "In the carriage and deportment of persons with pelvic spondyl-olisthesis nothing typically characteristic has been observed," and he endeavours to justify this statement by a collection of all the information published on the subject. Now, I believe that the analysis I have published in my various works, of the carriage of body, the mode of progression, and foot-prints, in the different stages of spondyl-olisthesis, completely disproves this view of Egger's. As for the rest I would refer to the description given further on of my Strasburg case, in which my presumptive diagnosis actually depended on the typical character of the mode of progression. On the etiology of these cases Egger says on pp. 29, 30, "It has already been mentioned that both these

patients had when young suffered from inflammatory processes in the sacral region, and these chronic processes probably extended to the joint between the inferior oblique process of the last lumbar and the articular process of the first sacral vertebra. In the first case (that of Engler) a fall while descending a small hill, in the second case (that of Haug) was the immediate cause of rupture of the ligaments and luxation of the oblique processes which had been the seat of that chronic inflammation, and thereby was the signal for the slipping in of the last lumbar vertebra."

He concludes on page 30 as follows: "Herr Hegar assures me that the delivery of Salome Haug was the most difficult he had met with in his extensive practice, and in his opinion the difficulty in the delivery of the head was considerably increased by the previous decapitation, whereby the possibility of fixation of the head was lost. In such cases eventration, or even the bisection of the trunk, would be preferable."

The diagnosis appears from the conditions as reported to have been correct in each case. I cannot, however, agree with Egger that the deformity was caused by the inflammatory processes in the sacral region which existed in earlier years, but would rather in each case attribute it as directly due to an injury, a fracture. In the second case a congenital spondylolysis interarticularis of the arch of the fifth lumbar vertebra may be accepted as a predisposing cause of the development of the deformity. Yet this idea seems rather at variance with (or somewhat hardy in view of) the principles I have elsewhere advanced on the development of olisthesis in early life, before the occurrence of pregnancy, &c., &c. How easily an accidental injury of this kind may be overlooked, is proved by those cases in which, though the occurrence of anything of the sort is denied, on the first investigation of the case it is nevertheless subsequently ascertained that such an injury did take place (*vide Archiv für Gynäkologie*, Bd. xix., Hft. 3, § 463). However, as I have completely proved elsewhere, all the results of anatomical and clinical study of the etiology of spondyl-olisthesis certainly oblige us in most cases to look on an injury as the cause, and in any case this second Friburg case is not singular as regards its etiology, for the same statements have been made in several others as to the time and manner of the commencement of the deformation—"Sudden sacral pain, without any alleged inducing cause."

It would not be easy to obtain a supplemental and more exact anamuesis in these cases. Salome Haug, for example, is now dead, and even if in these exceptional cases there is no history of any previous injury, we are nevertheless obliged, by the more exact details given in the vast majority of recent cases, to believe in the previous occurrence of an injury, or fall back on the existence of a congenital spondylolysis. It might also be said that in this second Friburg case, that the first attack of sacral pain and difficulty in moving about in the patient's 19th year must be attributed to some cause quite independent of the spondyl-olisthesis, and that the latter was only brought on by lifting a bucket of water in her 29th year, and therefore ten years later. To this I would answer that a better explanation for those symptoms which occurred in the patient's 19th year than a commencing olisthesis is, must at least be looked for. And moreover it is definitely stated that from the time of the first sudden attack of sacral troubles in her 19th, up to that of the injury in her 29th year, Salome Haug continually suffered off and on from sacral pain, and was obliged to look for an easier place of service. There is, therefore, in all probability a distinct connection between her sickness when 19 years old and that in her 29th year. Finally, from the pelvic measurements taken in 1873, from the account of the delivery, and also from the fact that Salome Haug's attitude in moving about was later on one bending over forwards, it appears that the spondyl-olisthesis was one of a considerable degree. Now the development of olisthesis is most gradual, according to our present clinical experience it is a question of years, and it is therefore far more natural to suppose that the process of olisthesis had as a matter of fact begun when the patient was 19 years old, and that the injury ten years afterwards, when she heard a snap in the sacral region, was important as making matters much worse. Indeed I would suppose that this injury in the 29th year corresponded with the moment in which the process passed out of the stage of spondyl-olisthesis of Lambl into the stage of spondyloptosis, in which a secondary infraction of the interarticular portions of the arch of the fifth lumbar vertebra took place, and that to this infraction is to be ascribed the sensation of the snap in the sacral region. I have elsewhere pointed out how under pressure and tension the arch of the fifth lumbar vertebra becomes elongated to the greatest

possible extent, and bent over forwards and downwards, and have theoretically deduced the occurrence of this secondary infraction, and am rejoiced to find this very interesting point in the anamuesis of Salome Haug supporting my theoretical deduction of secondary infraction of the vertebral arch, to avoid the repetition of which I refer to my earlier works on the etiology of spondyl-olisthesis. I would therefore consider the injury that Salome Haug suffered in her 29th year as a consequence of the maximum elongation gradually attained under tension of the arch of the fifth lumbar vertebra, on the occasion of a sudden increase of the body weight by taking up a burden, and I would date the origin of the olisthesis back to her 19th year, ascribing it principally to an injury sustained before that time, though not recorded in the anamuesis, and in a less degree to a congenital spondylolysis articularis of the arch of the fifth lumbar vertebra. That this latter as a matter of fact led to a spondyl-olisthesis is proved by the pelvis of the Hottentot Venus, the Prague-Wurzburg pelvis, that at Bonn, the second Wurzburg pelvis, and two cases of olisthesis of the body of the last lumbar vertebra but one, which I have myself described, and other cases also. In most such cases of congenital interarticular spondylolysis of the vertebra, which are indeed often enough accidentally revealed on a post-mortem examination, the ligaments which hold together the disunited portions of the vertebral arch are still powerful enough to keep the parts in position under pressure, and to prevent the slipping downwards and forwards, the displacement, the olisthesis of the anterior half of the vertebra, which is directly subjected to the body weight, and especially so if pregnancy does not occur.

Finally, this sudden and abrupt transition out of the stage of olisthesis of Lambl into that of complete spondyloptosis, accompanied by an appreciable "snap" in the patient's 29th year, induces me to believe that there was in this case a secondary infraction, which of course excludes the pre-existence of a spondylolysis.

The question of the genesis of this second Friburg case cannot be definitely settled from its history. But the experiences of the past two years have shown that spondyl-olisthesis lumbosacralis is however by no means such a very rare affection, and we may hope in future, by the greatest care in noting the anamuesis,

to obtain in every case decisive evidence as to whether the affection owes its origin to a fracture or to a congenital spondyl-olisthesis (? olysis) *sic.*

Nothing new is added to our knowledge of the symptoms of the disease by the histories of these two cases, though very many of the facts stated so completely correspond with or are supplemented by those recorded in other cases of the same sort, that I regret not having sooner met with this Friburg dissertation. The second case is particularly interesting obstetrically, showing as it does that though the character of the pelvis had not yet become that of one outwardly kyphotic in the extreme, the shortening of the conjugate diameter of the pelvic inlet was so considerable, and the delivery so exceptionally difficult, that Herr Hegar pronounced it to be more so than any he had met with in the many years of his extensive practice. In particular the distance between the great trochanters of the femora (31·5) still remained 3 cm. greater than the distance between the crests of the ilia, an excess still so large as to show that the rotation of the hip bones outwards, and proportionately therefore the rotation of the sacrum backwards, was as yet by no means considerable, and nevertheless the delivery by operation was exceptionally difficult. It is stated that the conjugata diagonalis spuria, measured from the pubic arch to an angle in the lumbar vertebræ, was 10·0 cm., but the particular angle or vertebra is not mentioned. It may be presumed that the smallest conjugate measurement of this pelvis lay above* the proper plane of the pelvic inlet, and indeed so high up that its dimension could hardly if at all be ascertained per vaginam, and could only be approximately estimated from measurements taken above it through the abdominal walls.

However that may be, there is exceptional interest clinically in the case of Salome Haug, because it proves that the degree of contraction of the pelvis in a conjugate direction, in and superior to the plane of the pelvic inlet, which is most to be thought of in delivery, cannot be estimated with absolute exactitude from the other dimensions of the pelvis. For example, in Minna Berndt (first Dresden case, 1882), in whom the distance

* This is also probable, from the fact that in Salome Haug, as also in Katharina Lommins, Theresa Barta, and Henriette Rudolph, when moving about the attitude of the trunk was bent over forwards, the inclination of the pelvis being more or less diminished.

between the crests of ilia was 27·5 cm., and that between the trochanters 27 cm., and therefore only 0·5 cm. less, while the distance between the tubers of the ischia was 6·0 cm., and therefore the external kyphotic character of her pelvis was far more developed, the natural forces were sufficient to cause the advance of the fœtal head as far as the pelvic outlet, and the pregnancy terminated normally in the birth of a living child, while in other cases, in which the external kyphotic character of the pelvis has been far less developed, the delivery has been fatal to mother or child, or to both. I cannot here digress to enter on this most interesting obstetric question, which I must leave for a separate work. I would only insist that the danger attending a delivery cannot be estimated from the external dimensions of the pelvis by themselves, nor is obstetric aid to be doled out by centimetres. One may indeed determine the amount of contraction in the outlet and cavity, and in favourable cases where the head presents and is still movable even that of the anatomical inlet, of the pelvis, but when labour is going on we cannot make an exact estimate of the contraction in the median plane above the plane of the anatomical inlet to the pelvis, the very seat in many cases of the greatest obstacle to delivery, of the greatest contraction. That not only during labour itself, but even when pregnancy is not far advanced, it may be very difficult under certain circumstances to feel the lumbar vertebral column in the plane of the anatomical pelvic inlet, or even somewhat lower down, was proved in the first Dresden case, in which at his first independent examination Winckel was unable to reach the lumbar column or angle of dislocation per vaginam, and only concurred with my diagnosis after he had again examined the woman lying on her side. Indeed in one case in practice, in which it was stated that on account of the fœtal parts presenting, the lumbar column could not be distinctly made out per vaginam, the obstetrician in attendance quite disregarding on that account the angle of dislocation, made his diagnosis of spondyl-olisthesis only on the external kyphotic form of the pelvis, the attitude of the body, &c., &c., combined with the absence of any kyphotic lumbo-sacral convexity. The place of the greatest contraction, whether in the median plane, or if the case is complicated by scoliosis, in a somewhat extramedian but parallel plane, is often out of the reach of digital examination per vaginam or per

rectum, and naturally one cannot on account of the pregnancy even reach the vertebral column through the abdominal walls. One can therefore in such cases do no more than estimate the degree of the inclination of the lumbar column forward compared with the inclination of the pelvis. It is not without reason that the spondyl-olisthetic pelves have been grouped among the pelves obtectæ. The task is to find out up to what distance the lumbar column has bent itself over towards the anterior arch of the pelvis. We have a means of approximately determining this contraction in the degree of lumbo-dorsal lordosis, in the attitude of the body, the amount of sinking of the thorax into the greater pelvis. A spondyl-olisthetic pelvis often enough passes unnoticed during a labour, for out of consideration of the exhaustion of the woman in her travail, the attending practitioner neglects to observe her attitude when standing up, and her gait when moving about (as was, for example, the case in the third Strasburg case to be hereafter described). It is therefore manifestly of particular importance to take at least one opportunity of observing the lying-in woman when standing up, at all events in those cases there is great and unexpected difficulty in delivery, from delay in the engagement of the child in the small pelvis, whether it be a spondyl-olisthetic or any other kyphotic, spondylizematic, rachitic, or osteo-malacic, pelvis obtecta, a *luxation pelvis*, or otherwise. And here also no measurements in centimetres from the upper margin of the pubic symphysis to the fifth, fourth, third, second, or first lumbar spine, nor to the dorsal or cervical spines, can lead to any exact conclusions, but the degree of inclination of the lumbar column to the plane of the pelvic inlet should be at all events approximately determined. One should keep before one's mind that inclination is the chief danger and primary obstacle in the way of labour in the pelvis obtecta, and modify one's conduct of the case according to the degree of this obstacle to delivery.

If once the obstetric inlet of the pelvis is passed, unless complications exist, the outlet is generally reached without special difficulty. Happily in most cases (as for example in both the Dresden cases, and many others) any operations which may still be necessary are undertaken at the pelvic outlet, and far less significance for the integrity of mother and child than those at the inlet of the pelvis.

*Third Clinical Case at Friburg.*

During a short visit I made to Friburg at the time of the meeting of scientific men (*Naturforscherversammlung*), Herr Hegar informed me that he had recently seen another clinical case of spondyl-olisthesis.

The woman in question, Frau Caroline Schweizer, 41 years old, from Hofsgrund (see the *Poliklinical Journal of the Friburg Clinique for Women*, 1883, i., No. 46), had had seven children and one abortion, and in the spring of this year had come to the Poliklinical Dispensary (*Ambulanz*) on account of some uterine affection. After Herr Hegar had diagnosed a spondyl-olisthetic pelvis, and she had been examined by Herr Wiedon, the assistant physician, also, the woman was requested to come another time in order that the anamuesis and present condition should be accurately taken; from that time, however, up till the present she has not again presented herself, and consequently the detailed description and history of the case are still to be expected in the future.

*Second Strasburg Case.**

I have to thank Herr Freund for the notes of the following case, which he examined two years ago with Herr Bayer, at that time his assistant.

Christine Kuiz, from Eschau, was sent to the Strasburg University Clinique for the Diseases of Women for the closure of a vesico-vaginal fistula. She was operated on on July 14th, and discharged on July 26th.

She had never been sick. Her menstruation, commencing in her 16th year, had been always regular, though rather painful. She had had nine children, of whom three had died, and of these two from protracted labour. All her confinements had been very difficult, in two cases because of cross-birth. There had never been any puerperal disturbances. In the last confinement ten weeks previously, the waters began to come away on Sunday. There were no effective pains till Monday night, and the child, which is still living, was born after excruciating pain on Tuesday evening. Immediately after the delivery the patient

* As the first Strasburg case I count the one described by von Hueter in 1875, as seen in the Clinique there at that time under Gusserow.

began to feel stabbing pains in the right groin and iliac region, which were greatly aggravated when she passed water. There was no other particular symptom, and micturition went on as before. She left her bed as early as the fifth day, and it was not until the eleventh day that she noticed that her water flowed from her vagina, as it has done ever since, though she can now and then pass a little water voluntarily. The catamenia have not returned since her delivery.

She is 150 ct. in height, strongly built as to bone. In the lumbar region there is extreme lordosis, with a most remarkable saddle-shaped sinking in of the loins, which is not altered in any movement she makes. There is an angle in the spinal column, between the sacrum and the lowest lumbar vertebra, the angle opening backwards. From the remarkably small difference between the diameters through the crests and trochanters, the external appearance of the pelvis is extremely kyphotic, being distinctly quadrangular, "like that of a cow." The sacrum sticks out prominently behind just as in a kyphotic pelvis, the rhomboid is pretty large, the nates very thin and remarkably hollow. The posterior superior spines of the ilia are well marked and tolerably symmetrical in position, the posterior S-shaped incurvation of the crest of the hip bones are remarkably abrupt and far apart.

The lines joining the S angles to the posterior superior spines on either side, when produced, intersect in an unusually obtuse angle, the apex of which is about 2·5 cm. above the commencement of the anal fissure. The abdomen is very short and pendulous, and consequently there is a well-marked fold of skin passing in a curve transversely above the symphysis pubis. The position of the navel is very low down, only 8 cm. above the symphysis, and the distance of the latter from the ensiform cartilage is only 20·5 cm.

Pelvic measurements—

| | |
|---|---|
| Distance between the trochanters | 30·01 |
| " " the crests of the ilia | 29·0 |
| " " anterior superior spines | 27·0 |
| " " posterior " | 8·5 |
| " " S angles of the curves of the iliac crests | 12·0 |
| " " tubers of the ischia | 8·0 |
| Length of the sacrum | 13·0 |
| External conjugate diameter | 19·5 |
| Length of the symphysis pubis | 6·5 |
| Conjugata diagonalis spuria measured to the lower margin of the fourth lumbar vertebra | 10·5 |

The genitals are situated pretty far forward. The vicarious conjugata vera, as measured externally through the abdominal parietes in narcosis, was 7·5 cm., and as some addition must be made to this for the thin abdominal walls it may be estimated at 8 cm. The pelvic outlet seems somewhat contracted transversely. On an internal examination one is at once struck by the high situation, great thickness, and remarkably upright position of the symphysis pubis, the cartilage of which is unusually large and prominent. The sacrum is very long, and its course from below upwards passes well backwards. At the level of the pelvic inlet the finger is stopped by the anterior surface, now quite horizontal, of the depressed body of the last lumbar vertebra, which rounds itself off backwards on either side, and extends well beyond the linea innominata; from either side of the projecting vertebral body the finger passes into an empty space; one can feel on each side of the prominent lumbar column a pulsating vessel, probably the two common iliac arteries, but the bifurcation of the aorta cannot be reached. The lower margin of the body of the fourth lumbar vertebra, which is within reach, takes the place of the promontory. The right half of the pelvis is in every way somewhat smaller than the left, corresponding with a scoliosis. The upper part of the back is flat, the left shoulder being higher than the right; no sign whatever of rickets.

The involuntary flow of water has caused eczema in the neighbourhood of the genitals. The anterior lip of the cervix uteri is slit up in the middle as if with a knife, and when both parts of the lips are drawn apart, one can see in the cervix, as large as a pea, the mouth of the vesico-vaginal fistula. The patient was operated on on 19th July, but had to be allowed to leave before the healing was complete. The complication of this case by vesico-vaginal fistula, the mode of origin of which can be easily understood, makes it particularly interesting.

The three clinical cases which fell under my own observation during the current year, and a fresh case from Paris, are now to be described.

I came across the first case accidentally while I was acting as assistant in the general dispensary (*poliklinischen Ambulanz*) of the Surgical Clinique of Berlin University.

I must, unfortunately, confine myself to the following short

registration of the case, as no complete notes or drawings are at my command.

*Second Berlin Case.**

Mrs. Auguste H., aged 52, the wife of a mechanic from the neighbourhood of Brandenburg, came in the spring of 1883 to the general surgical dispensary on account of a painful ulcer on the nose. Herr Sonnenburg, under whose direction the Policlinique was at that time, diagnosed a carcinoma, and immediately removed the neoplasm by operation. The appearance of the woman struck me as suggesting the existence of spondylolisthesis lumbo-sacralis by the short back, projecting hip bones, and by the peculiar attitude of the body and mode of progression. An inspection of the back and pelvis confirmed my suspicion, which was still further supported by an internal examination of the pelvis which I took the opportunity of making while the woman was under chloroform for the removal of the carcinoma. On account of her age examination per vaginam was of little use; I was, however, able to feel per anum, the lumbar column bending forwards, the angle of dislocation, the lateral angle, described by Breisky, &c. The external appearance of the woman, the sinking down of the thorax into the pelvis, the deep lumbodorsal groove, the folds of skin between the thorax and pelvis, the upright, heart-shaped buttocks, with deep lateral depressions over the incisuræ ischiadæ majores, the external kyphotic character of the pelvis, the pendulous belly, and the advanced position of the external genitals, all corresponded to the usual type.

Unfortunately I have not any measurements. The angle of dislocation lay very high, and if one passed the finger upwards along the posterior pelvic wall, could only be reached with extreme difficulty on account of the diminished inclination of the pelvis. It can be easily understood, that as in this sort of pelvis the sacrum is rotated backwards, and the distance from the arch of the pubes to the upper edge (indeed to the whole) of the body of the first sacral vertebra is thereby increased, and therefore the length of the conjugata diagonalis also, the manipulation of the examiner's hand is further obstructed by the con-

* I have counted a case in Rabenau's practice, described by Swedelin, as the first Berlin case.

traction of the pelvis in both transverse and conjugate directions, and one must press up the coccyx and soft parts with a certain amount of force. I may mention on this point that it is much better practically, instead of at first feeling along the anterior surface of the sacrum for the angle of dislocation, which, for example, in the cases of Olshausen and Billeter was indeed believed to exist but not properly reached by the finger, to pass the finger in the anterior vaginal vault or in the rectum directly upwards close along the posterior surface of the symphysis, and try first to feel the lumbar and vertebral column and the so-called false promontory. When the lumbar column is reached, as I have always been able to do without special difficulty in the nine living cases I have examined up to the present, one can then find the angle of dislocation more easily by slipping the finger back along the anterior surface of the lumbar column.

The fact that at times the angle of dislocation and the lumbar column can only be reached with great difficulty, unless the examination is conducted in an appropriate way, may be the reason that spondyl-olisthesis remains undetected in so many cases in practice, especially as during labour the presenting parts of the child make it still more difficult to reach the lumbar column and angle of dislocation with the hand unless the woman is examined standing up, or lying on her side.

When Mrs. H. had recovered from the chloroform, I eagerly sought for a detailed history of her case; it was interesting. She at first denied that she had suffered from any spinal affection, but afterwards admitted that since her 46th year she had had constant sacral pain, which she attributed to hemorrhoids; nevertheless a searching examination of the rectum and genital organs revealed nothing of a pathological character. The history, slight creeping pain in the sacrum and the gradual development, apparently almost without any symptoms, of the externally noticeable deformity, was certainly in favour of the suspected spondyl-olisthesis, although no injury or fall could be remembered. The negative results of the anamnesis recall several of the cases described by others.

That the diagnosis of spondyl-olisthesis was correct is extremely probable, any spondylizema may be at once excluded: any sort of exostosis of the lumbar vertebræ would in the first

place give rise to an abnormal condition to be detected on internal examination, and in the next place would not have caused the changes described in the external form of the pelvis. In any case the olisthesis may be one of no very high degree. Unfortunately nothing definite can be said as to the etiology of this case. The woman went back to her home the same day, and to my regret has not since returned to Berlin.

### *Third Berlin Case.*

Mrs. Clara Fischur, aged 28, the wife of a tinsmith of Brandenberg, applied for advice at the Surgical Clinique of Berlin University, on the 10th September, 1883, on account of sacral pains. The external appearance of this woman also was so strikingly suggestive of spondyl-olisthesis as to make me think at once that such was the case. This presumptive diagnosis was supported by examination of the woman, only leaving a certain indecision between spondylizema and spondyl-olisthesis lumbo-sacralis.

The patient had measles and scarlet fever as a child; menstruation commenced in her 16th year, and she was married when 24 years old. She has had two children, the first in January, 1880, and the second on 2nd April, 1882. The first child was spontaneously, two weeks too soon. The second was extracted by forceps, the head having been arrested for some hours at the pelvic outlet. Puerpery was normal on both occasions, but ever since her first confinement she has suffered from debility, and more or less sacral pain; her figure also has gradually altered so that she has become rather shorter, her hip bones have gradually become very prominent, and her abdomen became pendulous during her second pregnancy. She especially complains of stiffness in the sacrum and inability to exert herself; and in particular that she is unable to carry anything in her arms in front of her from the feeling that she must let her burden fall. It also struck her that during her second pregnancy she could not move about except when she held herself bent very much backwards. She passed through an attack of pneumonia shortly before the end of the first pregnancy, and was at that time bedridden for four weeks.

She cannot call to mind that when she was young she suffered

from an injury or a fall of any kind, but states that even as a child she could not bend herself forwards because of the pain she suffered in doing so, and was often scolded on that account, who, as Mrs. F. characteristically repeated, used to say, "Here am I an old woman stooping down to my work, and you, a young girl, can't do so." While still a girl, and therefore nine years ago, her mother suspecting that she had one high shoulder took her to the local physician, who did not consider any treatment necessary, but said it would grow all right again.

She concluded by saying that when she walks she always has a feeling of fatigue in the sacrum, and is obliged to support herself with both hands on her hips, thereby obtaining immediate relief. She has never suffered from any form of suppuration, nor from rickets, nor does she remember anything of the sort in her family. She had herself learnt to walk by the end of her first year, and apparently developed in due time.

Measurements—

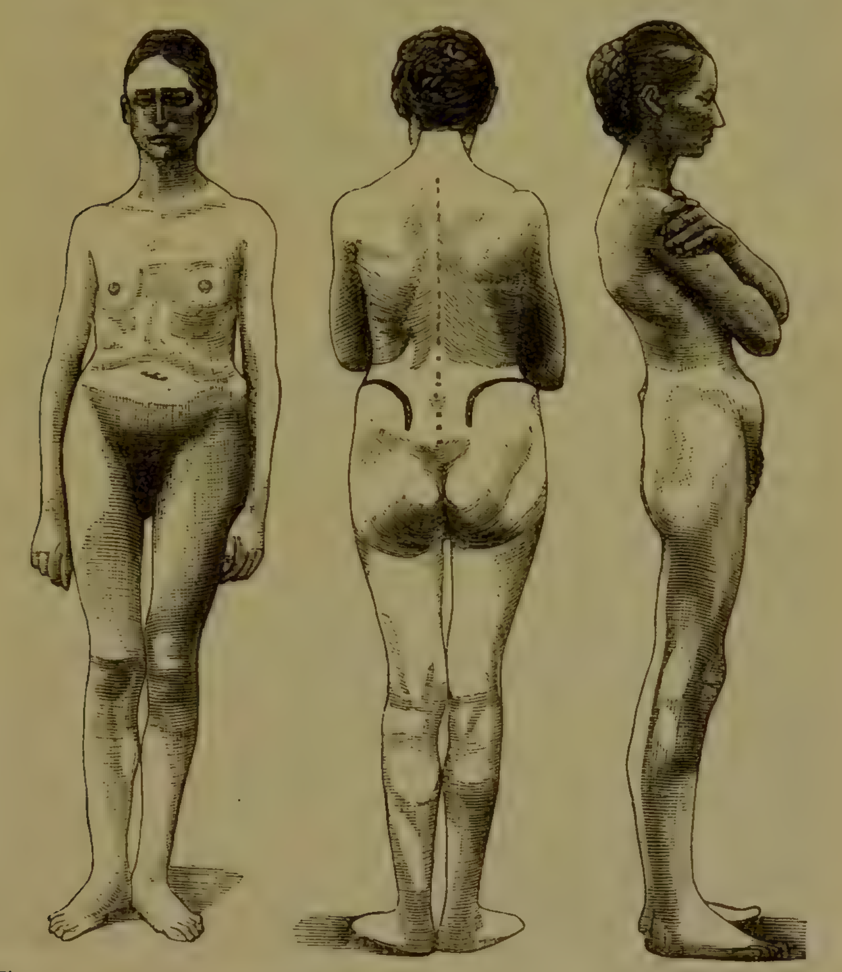
| | | |
|---|---|---|
| Height | 152·0 | cm. |
| Distance between the great trochanters | 30·0 | ,, |
| ,, ,, crests of the ilia | 29·5 | ,, |
| ,, ,, anterior superior iliac spines | 28·5 | ,, |
| ,, ,, posterior superior iliac spines | 9·0 | ,, |
| ,, ,, S angles of the posterior curves of the iliac crests | 11·0 | ,, |
| ,, ,, tubers of the ischia | 6·75 | ,, |
| External conjugate diameter | 19·5 | ,, |
| Conjugate diameter of the outlet | 6·5 | ,, |
| ,, ,, cavity | 9· | ,, |
| Direct distance from the pubic arch to the fifth lumbar spine | 19·0 | ,, |
| False conjugate diagonal diameter | 10·0(?) | ,, |
| ,, ,, of inlet of smaller pelvis | 8·0(?) | ,, |
| Length of the symphysis pubis | 6·5 | ,, |

Instead of a minute description of the noticeable points of the individual deformity, which would be almost an exact repetition of that of other similar cases, I give (figs. 1, 2, 3) three drawings showing in the clearest way the external configuration of this woman, in the trace of whose footprints it is most interesting to find that character corresponding to a pelvic spondyl-olisthesis of a moderate degree.

From the drawings and measurements given above it is quite evident that in this case we have to do with a pelvis, externally of the so-called kyphotic character, and with a pelvis obtecta, and after the exclusion of other abnormalities, the differential diagnosis

has to be made between spondylizema and spondyl-olisthesis lumbo-sacralis as illustrating which the case is particularly interesting.

From a consideration of the posterior and lateral views of the woman (figs. 2 and 3) it will be seen that though there is no



Figs. 1, 2, 3.—Anterior, posterior, and lateral view of Mrs. Clara F., II-para aged 28.

pathological angle in the upper part of the vertebral column, the fifth lumbar spine forms a projection behind somewhat like a lumbo-sacral kyphosis. One can however convince oneself that the projection is formed by the fifth lumbar spine only, for it can be readily felt above and below, and on either side, and a kyphotic gibbus consisting of one single spine may be said to be

never found except as a cervico-dorsal kyphosis. Besides, if this convexity was kyphotic, or rather as it is in the lumbo-sacral region spondylizematic, the lumbar column would be far more inclined forward *in toto.* The fifth lumbar spine sticks out by itself exactly as in the spondyl-olisthetic pelves at Munich and Zurich, cases in which during life it was thought to be the first sacral spine. In angular pathological kyphosis, the spines of those vertebræ of which the bodies have given way under the action of caries form *in toto* a less acute curve, while here the fifth vertebral spine projects quite independently, and the fourth lumbar spine stands back from it like the step of a staircase. For example, if one compares this profile (fig. 3) with the lateral view of Mrs. Ottilie Grassau,* a woman with a spondyl-olisthetic pelvis, one can immediately see the remarkable difference between the blunt lumbo-sacral convexity of the less acute kyphosis in Mrs. Grassau, and sharply isolated projecting lumbar spine in this case. Between the latter and the rest of the lumbar column there is in this case that angular, saddle-shaped depression caused by the upper part of the lumbar column (that is, the whole of the spinal column down to the fourth lumbar vertebra), and the anterior half of the fifth lumbar vertebra, including the body and anterior half of the ring, upon which indeed the superior part of the spinal column rests directly, has slipped down forwards, while the posterior half of the fifth lumbar vertebra, that is to say its spine, only has remained behind upon the sacrum. Strictly speaking, therefore, this saddle-shaped depression in the posterior aspect of the spinal column lies between the arches of the fifth and fourth lumbar vertebræ, and not directly between the sacrum and lumbar vertebral column. Indeed the character of this angular saddle-shaped depression is so typical, that in itself it seems sufficient to exclude spondylizema in this case as against spondyl-olisthesis.

In the next place, in spondylizema, as has already been pointed out, the spinal column and upper part of the body would be inclined more forwards, as is represented in the picture of Mrs. Grassau that has been referred to; but in Mrs. F. the

* Neugebauer, "Zur Casuistik des Spondylolisthetischen Beckens," *Archiv für Gynäkologie*, Bd. xix., Hf. 3, S. 448, fig. 3; or Winckel, *Klinische Beobachtungen zur Dystokie durch Beckenenge.* Leipzig, 1882, Tafel II., fig. 6.

attitude of the upper part of the body is one still inclined backwards. In olisthesis the body is not bent over forwards till the degree is extreme.

Thirdly, there are no statements in the anamuesis to be referred to the development of a spondylizematic pelvis. And yet such a development is never so completely hidden; the characteristic group of symptoms associated with Potts' curvature are familiar enough to be omitted here. On the other hand, the development of spondyl-olisthesis is, for the most part, almost without symptoms, but rarely rapid, and occasionally its gradual progress is greatly promoted by intercurrent pregnancies.

Now in the present case some anomaly had existed ten years previously, for the girl, though almost quite healthy, could not bend herself forwards, and from her first conception the deformity was continually becoming greater, especially so during her second pregnancy, from the renewed and continued increase in the weight on the lumbar column.

Five days after the first examination I took the woman to the Berlin University Clinique for the Diseases of Women, and asked Herr Schröder, and Herr Müller of Bern, who was present at the time, to examine her. The apex of the angle of dislocation could not now be distinctly felt, and the soft parts about it were so considerably swollen, almost fluctuating, as to suggest the possible presence of a commencing, descending abscess at the promontory of a well-marked Potts' kyphosis of the lumbo-sacral region. This caused Herr Schröder and Herr Müller to have some doubt as to whether the case was not one of spondylizema. This swelling of the soft parts struck me the more, as it had not been so considerable five days before at the time of my first examination, after which the woman had suffered for twenty-four hours from pain in the abdomen. I had, on that first occasion at the general clinique, on account of the great interest afforded by the case, allowed a large number of medical men and students to examine the woman, and it is quite possible such repeated examination was not without results. Besides, a quite similar swelling of the soft parts existed on the examination of Henriette R. of Halle, Amalie H. of Dresden, and Francisca D. of Prague. And this circumstance is no evidence against olisthesis, for it may well be admitted that such marked deformation and disloca-

tion of the vertebral column cannot take place without an accompanying condition of irritability in the surrounding soft parts. Quite apart, however, from this, and from the history of the case, several other points corroborate the diagnosis. As has been stated, the angle of dislocation was on one occasion felt below the level of the anterior superior margin of the os sacrum, while in a case of lumbo-sacral spondylizematic kyphosis the apex of the angle of flexion is situated exactly at this margin, and therefore the finger tip passing outwards on either side from this angle of flexion must hit upon the anterior edges of the lateral masses of the sacrum. Moreover, the thickness of the posterior pelvic wall in a median plane at the level of the plane of the pelvic inlet is evidently too great; the posterior pelvic wall now consists at this place of the body of the fifth lumbar vertebra + the body of the first sacral vertebra, the posterior arch, and the spine of the fifth lumbar vertebra, a diagnostic mark on the value and mensuration of which, by means of subtracting the direct thickness of the posterior pelvic wall at this part from the length of the external conjugate diameter, and so getting the length of the false conjugate, I have already written in my earliest work and elsewhere.*

We have, finally, the assistance of the characteristic condition of the solid angle of Breisky, as well as the circumstance that to reach the lateral parts of the anterior superior margin of the base of the sacrum one must on each side pass one's finger upwards along the posterior pelvic wall above the depressed body of the fifth lumbar vertebra. The history of the case, its course and symptoms, the progress of the development of the existing deformity, the attitude of the body, &c., all give additional support to the clinical presumptive diagnosis, every objection to which may in the face of these circumstances be considered removed, as indeed Herr Schröder himself considered.

Mrs. F. had stated that she found relief if she supported

* *Zur Entwickelungeschichte des Spondylolisthetischen Becken's u.s.w.*," S. 36, ff. "A further peculiarity of the spondyl-olisthetic pelvis is found theoretically and practically in the position of the lumbar vertebræ (especially of the fifth lumbar vertebra) in front of the first sacral vertebra. The increase in the direct thickness of the posterior pelvic wall at the level of the base of the sacrum which this causes, leaves a striking difference between Baudeloque's diameter and the conjugata pseudo-vera, &c."; and S. 37, "If in certain cases we were able to measure with instruments the thickness of the posterior pelvic wall, the estimation of the conjugata spuria from Baudeloque's diameter would (*sic*) be possible," *et sequent.*

herself when walking by placing her hands on her hips. It was, therefore, only following the hints of nature for us to lessen, as far as possible, the burden on the lumbo-sacral joint by a supporting apparatus, as I had already done in a case at Halle, where Volkmann had also done it in a case of his own. I applied a provisional plaster of Paris corset to the woman in Sayers' sling, with the assistance of Dr. Barth of Berlin, intending if this was of the desired benefit to have a felt splint apparatus made for the case. The patient felt immediate relief after the application of this corset, and journeyed home contentedly. On the 25th and 27th September she wrote to me, saying that the corset had been for the first few days rather uncomfortable and burdensome to her, but that now she could sleep better at night, and get about better in the day time, and was very contented with it. The corset must indeed relieve her, but how will it be with the deformity?

As a rule the development of the latter is only arrested when in the stage of complete spondyloptosis the bodies of the two vertebræ concerned form with each other a right angle, or even an acute angle. Then if the arch of the fourth lumbar vertebra has come to rest almost directly upon the first sacral vertebra—that is to say, if the body of the first sacral vertebra has then been forced so far into the aperture of the vertebral canal in the fifth lumbar vertebra, that either it has completely separated the anterior and posterior halves of the arches of the fifth lumbar vertebral ring, or the interarticular portions of the ring have elongated and wasted away under the extreme pressure—no further elongation of the arch of the fifth lumbar vertebra results; the body of the fifth lumbar vertebra then lies entirely against the anterior surface of the sacrum, its axis quite perpendicular, or even at an acute angle to that of the first sacral vertebra. Now, then, should every attempt to lessen the pressure be abandoned in order to promote the development of the deformity to this extent? Fortunately this is not the case, for experience has shown that an arrest, and consequently a cure by synostosis, may take place at any stage of spondyl-olisthesis. Another pregnancy would be the most likely thing to render all curative treatment useless. I will however, if possible, keep the case under observation, and hope to be able to give an occasional report of this attempt at the orthopœdic treatment of the disease.

### *Third Strasburg Case.*

On page 53 of my earliest work I said*:

"Experience has not taught me that I undertake too much in promising to recognise any woman with a spondyl-olisthetic pelvis among the throng in the street."

The peculiar appearance of such persons has become still more familiar to me since I wrote this. It was on the 7th October of last year that Dr. Swedelin, of St. Petersburg, and I met in Strasburg in one of the streets by the Minster a woman in the costume of Alsace, whose external appearance was so striking that I looked at her more carefully. Both the manner in which she held her body, and her mode of progression, were those of spondyl-olisthesis lumbo-sacralis. When I had learnt, through a third person, that she suffered from sacral pain, had been delivered by forceps, &c., &c., I soon got the good woman to come to the Gynæcological Clinique, where I could justify the accuracy of my presumptive diagnosis to my friend. In it Doctors Freund, Haeckel, and Swedelin completely concurred, and the following representations should remove any doubt of it:—

Measurements—

| | | | |
|---|---|---|---|
| Height | | | 154·0 cm. |
| Distance between the iliac crests | | | 32·0 ,, |
| ,, | ,, | great trochanters | 31·0 ,, |
| ,, | ,, | anterior superior spines | 28 0 ,, |
| ,, | ,, | posterior ,, | 9·5 ,, |
| ,, | ,, | S angles of the iliac crests | 14·0 ,, |
| ,, | ,, | tubers of the ischia | 6·7 ,, |
| Conjugate diameter, external | | | 18·0 ,, |
| ,, | ,, | normal | 18·5 ,, |
| ,, | ,, | of the cavity | 10·0 ,, |
| ,, | ,, | of the outlet | 7·5 ,, |
| ,, | ,, | to angle of dislocation | 12 0 ,, |
| ,, | ,, | to most prominent part of the lumbar vertebræ | ? |
| ,, | ,, | false | about 9·5 cm. to 10·0 ,, |

The pelvis was slightly unsymmetrical from scoliosis. A simply unilateral olisthesis could not be certainly made out. While the lordotic lumbo-sacral groove was very deep, on account of the thickness of the integument, and the plentiful development of subcutaneous adipose tissue could be but very indis-

* *Zur Entwickelungsgeschichte des Spondylolisthetischen Beckens und seiner Diagnose* (mit Berücksichtigung vom Korperhaltung und Gangspur). mit 97 Holtzschnitten im Texte Halle und Dorpat, 1882.

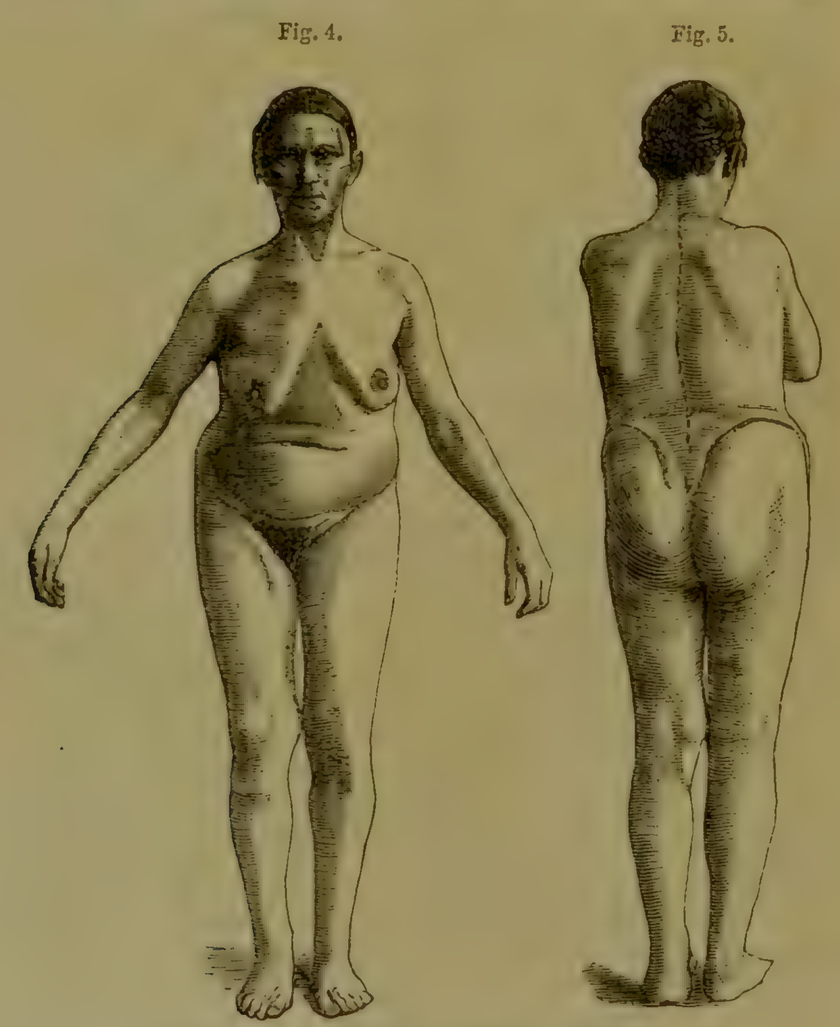
tinctly made out, on the other hand the sacral hiatus, and the fourth and third sacral spines, were easily felt.

The spinal column exhibited a compound scoliotic rotation—in the cervico-dorsal portion to the right, in the dorso-lumbar to the left, and in the lumbo-sacral back to the right; the right hip projects more backwards, and at a greater angle with the trunk than the left, on which side the line from the axilla to the crest of the ilium is straighter or more easily curved. The thorax is turned about, and sunk down into the pelvis, as the folds of skin across the abdomen above the pubes show. The rotation inwards of the lower end of the sacrum and the coccyx is evident externally from the prominence of well-marked lateral depressions in the buttocks corresponding to the greater sciatic notches. The pendulous abdomen, the anterior position of the genitals, and the diminished inclination of the pelvis, can all be seen in the pictures (figs. 4, 5, 6). I have also added a picture of the woman in costume, since it was this view of her, supported by her peculiar manner of walking, that forced the diagnosis on me.

These pictures show the most remarkable agreement in most points with the many others published. As a matter of fact the appearance of a person affected with a high degree of spondyl-olisthesis lumbo-sacralis is so striking that it impresses itself on the memory for ever, and without any special examination this deformity, hitherto considered an extremely rare one, betrays itself in the ordinary intercourse of daily life. In proof of this I will insert here without any comments figs. 9, 10, 11, which represent Mrs. R., of Berlin, in her ordinary dress, a woman delivered by Dr. v. Rabenau in 1883, and described in the *Archiv für Gynäkologie* by Swedelin, and suggest a comparison of fig. 7 of this work and the pictures in Swedelin's article.

Mrs. Sophie O., 45 years of age, a native of Nymphersheim, and the wife of a joiner in Strasburg. As a child had always good health, and was well developed, but while still a young girl she was subject to sacral pain, and was never able to lift up anything heavy from the ground, or to carry it; she was particularly unable to carry anything in front of her. She has had three children; her first labour, eleven years ago, was comparatively easy; the next, eight years back, more difficult; and one

a year ago, when as the head remained for more than three hours at the outlet, Dr. Hueter had to deliver with the forceps. Since the last delivery but one, the sacral pains have increased, and a deformity has developed ; the patient has got shorter, and her hips have gradually become more prominent in the mean-




Figs. 4—7.—Mrs. Sophie O., 45 years old, III-para.

time, but especially during the third pregnancy her abdomen has become pendulous to a burdensome extent, and her previously normal gait has turned to a waddle.

The track of her footprints (fig. 8) is that characteristic of a person with a pelvis of an externally kyphotic form which I have

fully delineated in my previous works. I would only add that with the waddling gait like that of a duck the upper part of the body sways freely from side to side.



Fig. 6. Fig. 7.

Herr Hueter, of Strasburg, informed me that he never saw the woman again after her delivery. As he found the head already lying in the outlet, he made no exploration of the pelvis, and only states that the outlet was very decidedly contracted transversely.

Fig. 8.—Footprints of Mrs. Sophie O., $\frac{1}{5}$th natural size.

*Case at Paris.*

When I was visiting Professor Charpentier in Paris, he drew my attention to the striking resemblance which a woman he had seen in 1868 bore in external appearance to the picture of Mrs. Berndt (see fig. 13, inserted for comparison, on page 39). This woman had been a patient in the Obstetric School at Paris in 1868 for her fourth confinement, which terminated naturally, and the late Professor Depaul, at that time director of the institution, had diagnosed a congenital dislocation of both femora, and two photographs taken at the time were afterwards inserted in the text books as typical of the appearance of the trunk in this dislocation; for example, in Charpentier's own text book, *Traité des Accouchements*, Tome ii., p. 116, figs. 418, 419; and in Guéniot's treatise, *Des luxations co.co-fémorales soit congénitales, soit spontanées au point de vue des accouchements*, Paris, 1869, pp. 108, 109, figs. 11 and 12. Was this woman's pelvis really one with bilateral femoral luxation, or was Depaul mistaken in his diagnosis? I do not myself think there was any dislocation of the femur in the case; at first sight the waddling gait (*marche en canard*), which is a characteristic of these dislocations, but which is often associated with a spondyl-olisthetic, together with the general deformity and shortening of the body, might well suggest such luxation; besides which the symptomatology of the spondyl-olisthetic pelvis was at that time little understood, had indeed been so little studied that this affection of the pelvis was as a rule overlooked. A careful consideration of these pictures (figs. 12—14) will, however, at once show that the trochanters are in their normal position; that the greatest width of the pelvis lies in the line between the iliac crests, and not in that between the trochanters; that the shortening is in the lumbar region, and not in the upper thighs; that the pelvis corresponds in shape with the so-called kyphotic pelvis, that is to say the change it has undergone is exactly opposite to that which takes place in luxatio duplex femorum iliaca. The shape and position of this pelvis, its diminished inclination, the prolonged appearance of the lower extremities, the form of the buttocks, the anterior position of the external genitals, and the general external configuration, most certainly indicate not only that there is no luxation of the femora, but that there was here some




Fig. 9—11.—Anterior, posterior, and lateral view of a woman with a spondyl-olisthetic pelvis (spondyloptosis).

form of the pelvis obtecta, and that that form is either spondylizematic or spondyl-olisthetic, and since the posterior view proves the absence of any projecting gibbus, the pelvis must consequently have been spondyl-olisthetic.

For the rest, Doctors Charpentier, Guéniot, Tarnier, Porak. Doléris, Trélat, Desprès, and several other Parisian obstetricians and surgeons, to whom I stated this deduction, completely agreed with it.

I will not argue further in favour of my view of the case, as I believe these drawings afford a proof of its accuracy, and will only mention a most simple key to the analysis of such cases by the proportions of the pelvis in length and breadth.

By a comparison of figs. 15, 16, 17, and 18, we can see that if in each of these diagrams we lay down the bitrochanter line A B, the line joining the crests of the ilia C D, and if on either side join A to D and B to C by straight lines A D and B C produced to meet on that side to which they converge, these lines from the iliac crests to the trochanters will intersect in some point E, which in the normal pelvis (fig. 15) lies a long way above the bitrochanter line, in the luxation pelvis (fig. 16) it lies considerably lower down, while in the spondyl-olisthetic pelvis it lies below the bi-trochanter line.

In the first case, and also in the second, the figure A B C D forms a trapezium with the base downwards; in the third case the base of the trapezium is the upper line C D; or taking the isosceles triangle A B E, in the two former cases the apex E is situated above the pelvis, while in the third case it is below it. The shape, height, and width of the trapezium and triangle are of course quite different in the three cases, and are typical in each diagram. Now in an outline sketch of Depaul's case (fig. 18), treated in the same way, the base of the trapezium and of the triangle is formed by the bitrochanteric line, though in this case the triangle is not isosceles, its apex being displaced to the right by the existing scoliosis. The variation in the figures here shown has its primary basis in the alteration of the position of the hip bone in relation to the femur.

The changes in the shape of the pelvis are represented diagrammatically in the transverse perpendicular section of the pelvis (fig. 19). In the normal pelvis A B C D, straight lines drawn through the sides of the pelvis intersect when produced at




Figs. 12 and 14.—Anterior and posterior view of a woman delivered naturally of her fourth child at the School of Obstetrics at Paris, in the year 1868, during the direction of Professor Depaul, the presumptive diagnosis *ex aspectu* being pelvis spondyl-olisthetica (drawn on a diminished scale from a photograph).

Fig. 13.—Minna B., aged 26, in her second pregnancy, inserted for comparison (from Neugebauer's paper, *Archiv. für Gynäkologie*, Bd. xix., S. 448, fig. 1).

the angle X, in the luxation pelvis under consideration, these lines intersect at an angle Z, which is more acute, and of which the apex lies lower down, while in the spondyl-olisthetic pelvis the angle of intersection is more obtuse, and its apex lies higher up. Corresponding to the alteration in the pelvis, the hip bones, apart from their characteristic change in shape, their increased or diminished length from behind forwards, are rotated outwards in the spondyl-olisthetic pelvis with a decrease, and in the luxation pelvis in the opposite direction, as is shown by the arrows in the diagram.

*Direction of Rotation of the Hip Bone.*

The height, *h h*, of the pelvis, &c., &c., is proportionately altered. This diagram is only designed to illustrate the fundamental principles above-stated, and therefore all other marks of the two anomalies are omitted, indeed I have not even inserted the head of the femur in its dislocated positions, because there are various forms of this dislocation, each of which would require a separate diagram. Nor have extreme cases been held in view; what has been said is borne out by ordinary cases.

In spite of all my efforts I could unfortunately learn but little of the history of the labours or sickness of the Parisienne G. The scanty notice in the journal only stated that on the 18th May, 1868, Elise Guinot, a milliner, aged 27½, was admitted into this institution in her fourth confinement, the three previous ones having been premature. She was delivered on the 20th May after a natural labour, and discharged on the 1st June. The infant was healthy, weighing 3,160 grammes.

In reference to the anamuesis it is said (*l. c.* in Guéniot): "1st pregnancy, abortion at three months and a half; 2nd pregnancy, abortion at six months; 3rd pregnancy, labour at term, prolapse of the cord caused the application of forceps; 4th pregnancy, natural labour."

Finally, there is a remark in pencil writing in the Clinical Journal of the confinements: "The patient has a considerable convexity at the level of the lumbar region."

This last notice is of special interest, inasmuch as it appears to contradict my deduction as above. In the meanwhile a careful consideration of the back view in the original photograph

Fig. 15.

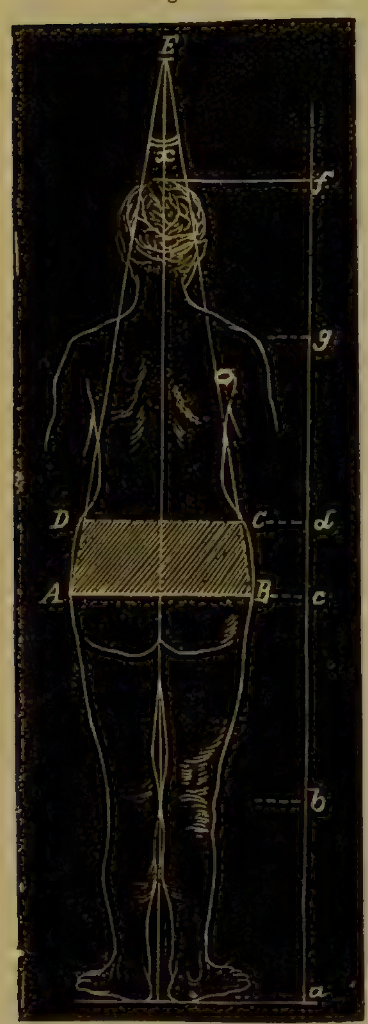
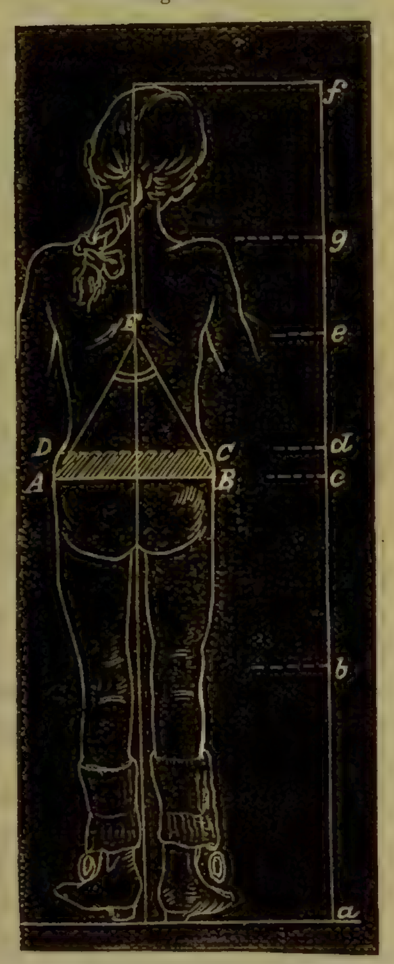



Fig. 16.




Figs. 15—18.—Outline diagrams (Figs. 15, 16, and 18 drawn from photographs).

Fig. 15.—Normal configuration (See Neugebauer, *Archiv für Gynäkologie*, Bd. xix., S. 450, fig. 4).

Fig. 16.—Configuration in luxatio femorum congenita iliaca duplex. (After Hamilton.)

shows that no convexity in the sense of a spondylizematic pelvis existed, it is therefore probable that the term "considerable convexity" was applied to the very prominent lower part of a spondyl-olisthetic lumbar saddle, that is, to the base of the sacrum, together with the fifth lumbar spine.

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A few weeks ago chance once more threw in my way an observation that is, I think, appropriate here. My attention was attracted by the peculiar conformation of a woman 26 years old, the daughter of a master baker, P. Unfortunately all my efforts to arrange for a proper examination of the case were upset by the opposition made by her and her relatives. I have nevertheless no hesitation in going into the case, for I entertain a firm opinion that sooner or later the maiden, provided she gets married, will come under medical observation; I have particularly recommended her to the attention of a colleague in Paris.

Miss P., as a child, well-formed, and well-developed for her age, free from hereditary disease. When 2 years old she had a fall, and since that time until two years ago has suffered more or less, and was for ten years under medical treatment. Her first symptom was a difficulty in moving about, followed by vague pains in the sacral and lumbar regions; she was never bedridden for any considerable time, and her illness was of an insidious character with few marked symptoms. At first one knee was treated with sinapisms; later on the affection moved up to the loins. The most prominent mark of the disease was a very gradual shortening of the upper part of the body and lateral growing out of the hips. Her dresses became too long for her; her attitude, however, remained upright, and she had no forward stoop. There was never any fever or suppuration, or anything of the kind, and her general condition as to nourishment and strength was always good. For the last two years the pains in the sacral region have more or less gradually disappeared, so that at present she does not feel ill. This is all I was able to learn. Her external appearance bears the closest resemblance to that of Mrs. R. of Berlin (*vide* figs. 9—11 of this work), but unfortunately I cannot exhibit a single picture of her. From her

Fig. 17.

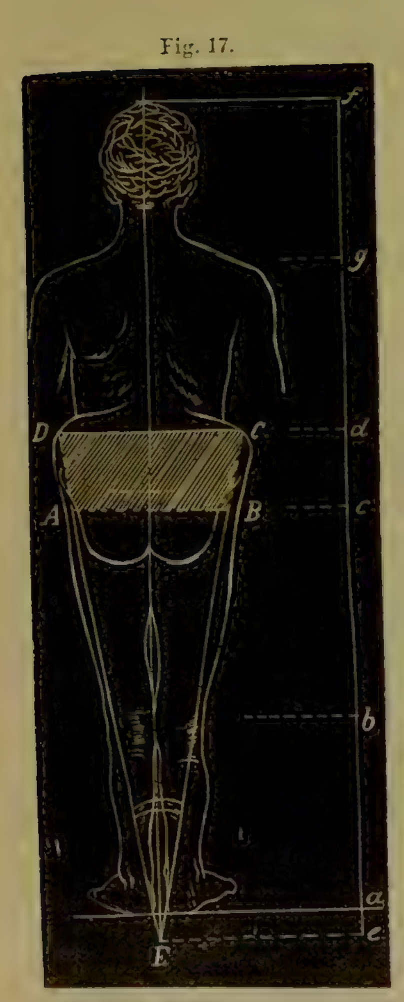



Fig. 18.

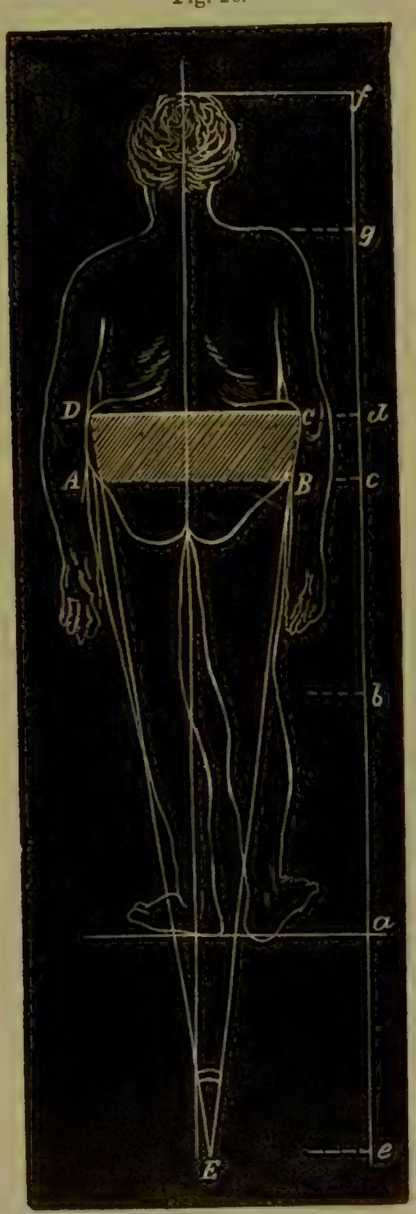



Fig. 17.—Configuration of the spondyl-olisthetic pelvis. (See Neugebauer, *loco cit.*, fig. 6.)

Fig. 18.—Configuration of the Parisienne G. (From a photograph taken by Depaul in 1868.)

*AB* Bitrochauter line.
*CD* Bicristal line.
*E* Point of intersection of the lines from the trochanters to the crests of the ilia when produced on the side of their convergence.

external appearance and gait she certainly has in my opinion a pelvis obtecta of an outwardly kyphotic character, and both from her exceedingly upright attitude, and from the history of the case, I believe that she has a spondyl-olisthethic pelvis. Potts' disease in the lumbar region, or Herrgott's spondylizema, may exist without any sinking down of the spinal column over the pelvic inlet, and without forming any characteristic convexity, but I doubt whether a high degree of pelvis obtecta spondylizematica can occur without a hump or without decided inclination forwards of the upper trunk. I would also refer to the differential diagnosis between *spondylizema* and *spondyl-olisthesis* in the case of Mrs. Ottilie Grassau, of Dresden (*vide* Neugebauer, *Archiv für Gynäk.* Bd., xix., Hft. 3, fig. 3, &c.).

From my past experience I might reckon this as the second, or, if the Hottentot Venus is counted, as the third Parisian case of spondyl-olisthesis. I will, however, at present simply mention it here as the results of a more exact internal and external examination have still to be obtained, and I have not even a picture to illustrate the case, moreover all possible care has been taken to secure sooner or later the particulars of the case for the benefit of science. If the presumptive diagnosis I made from her appearance is not correct, no loss can in any case result to our diagnostic knowledge. May I be allowed to add here some explanation of the difference of opinion existing between Herrgott and myself in respect to the genesis of spondyl-olisthesis?

As is well known, Herrgott (sen.), of Nancy, published in his time several works upon the spondyl-olisthetic and the lumbo-sacral kyphotic pelves, and made use of the expression "spondyl izematic" pelvis to describe the latter (σπόνδυλος=vertebra, and ἴξημα=sinking, depression, *Lusammen-sinken*).

In this Herrgott essentially improved the nomenclature of the pelvis. In Germany we are in the habit of speaking of a pelvis as kyphotic if we mean the pelvis of a person affected with kyphosis of the vertebral column, but in these cases the pelvis itself is not in the least kyphotic, its posterior wall exhibits no hump of any kind, but it is a pelvis changed in shape by the body weight in consequence of a kyphosis of some part of the vertebral column, be the same higher up or lower down, though it is true that this change in shape varies in degree according to

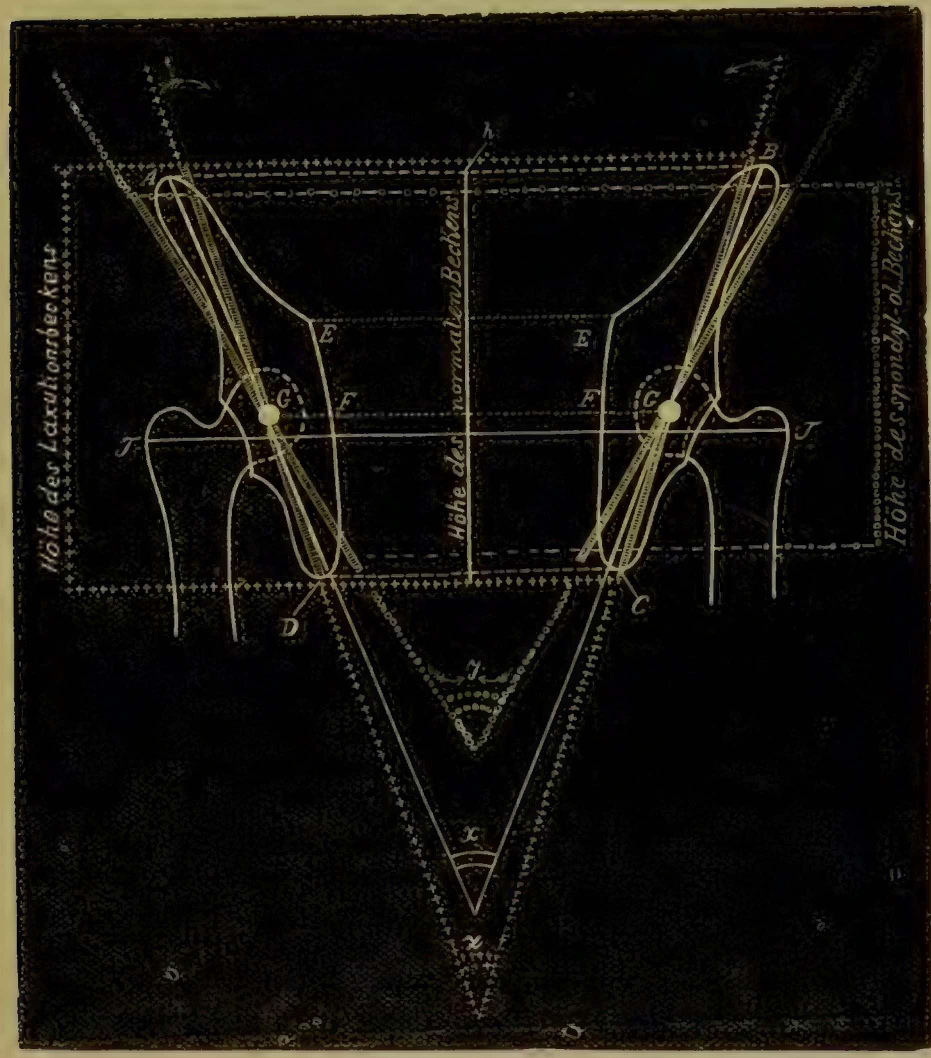



Fig. 19.—Metamorphosis of the diagram of the transverse section of the pelvis.

——— Normal pelvis.

++++ Pelvis with luxatio femorum duplex iliaca congenita.

oooooooo Spondyl-olisthetic pelvis.

*AB* Line between iliac crests.

*TT* Bitrochanter line.

*EE* Transverse diameter of inlet } of the pelvis.

*FF* „ of hollow } of the pelvis.

*CD* „ of outlet } of the pelvis.

*GG* Transverse axis of the pelvis.

*hh* Height of normal pelvis.

*x* Angle of intersection of the straight lines through the sides of the normal pelvis, produced.

*y* Angle of intersection of those of the pelvis with luxatio fem. iliaca congenita.

*z* Angle of intersection of those of the spondyl-olisthetic pelvis.

Direction of rotation of the hip bone.

the position of the kyphosis. The pelvis itself is kyphotic only when its posterior wall has a share in the formation of the hump (κῦφυς). But from an obstetric point of view the anatomical character of a kyphotic pelvis varies so much with the situation of the kyphosis, that it seems to be essentially desirable to distinguish at all events the principal forms of it by different expressions; and unless we are willing to use the expression kyphotic pelvis only in cases of lumbo-sacral kyphosis, and to describe the other cases as pelves with dorsal kyphosis, &c., a separate description of the lumbo-sacral kyphotic pelvis, such as Herrgott has invented for it under the expression spondylizematic, is very desirable, and we can then continue to include under the term kyphotic those pelves in which the kyphosis is situated higher up, though the term is not strictly accurate. A separate description of the lumbo-sacral kyphotic pelvis seems the more necessary, since it is always of a character essentially different from any other so-called kyphotic pelvis. While in the latter the change in the dimensions of the smaller pelvis has alone to be considered, in the former the size of the greater pelvis is altered, and there is a contraction in its conjugate diameter of much importance in obstetrics. In the lumbo-sacral kyphotic pelvis we have a "pelvis obtecta," which obstetrically is twice as important as any other so-called kyphotic pelvis. Moreover a description of the lumbo-sacral kyphotic pelvis different from the spondyl-olisthetic is most desirable for diagnosis, and consequently Herrgott's expression spondylizema is doubly welcome.

Now Herrgott has wished to include spondyl-olisthesis and spondylizema in one general group of pelvic deformities caused by one and the same process, Potts' disease, and has made this distinction between them.

(*a*) If the bodies of the vertebra are affected and lose their resistance, the spinal column sinks downwards and forwards with the formation of a lumbo-sacral hump (in consequence of their obliteration)—spondylizema.

(*b*) But if it is the vertebral arches which are affected and lose their resistance, so that they can no longer effectually oppose the tension caused by the pressure on the lumbar vertebral body, the body of the fifth lumbar vertebra slips down forwards, resulting in spondyl-olisthesis.

In French literature this view of Herrgott's has been so

generally adopted up to the present time, that for example Charpentier in his lately published text book in 1883 does not even enter on the discussion of other and more recent theses, and even sets down in a categorical manner Potts' disease as the unique cause of spondylizema and spondyl-olisthesis, although this view has long ago been set aside, and as we shall see further on, is now abandoned by Herrgott, its originator, himself.

In my previous works I have given prominence to the proof that in relation to its origin, spondyl-olisthesis differs most essentially from spondylizema; for while in the latter there is a specific caries with loss of substance, and with or without suppuration, that is to say Potts' disease, in olisthesis there is neither caries nor loss of substance, and up to the present time caries, even when affecting the vertebral arches, has in no single well proved case caused olisthesis properly so-called. (In the cases of Blasius and Ender it appears to me that the diagnosis was by no means established.) I have looked upon spondylizema, *i.e.*, Potts' curvature, more as a deformity caused by a dyscrasia, spondyl-olisthesis on the other hand as purely surgical, and have referred the genesis of the latter exclusively to a congenital defect in ossification, or to a corresponding fracture.

Herrgott having become acquainted with my works, has done me the honour to translate into French as much as relates to the etiology of spondyl-olisthesis (*vide Annales de Gynécologie*, Mai 1883: "Spondylizème et spondyl-olisthésis, nouveaux documents pour l'étude de ces deux espèces de lésions pelviennes") and has taken up the following position.

In the first place, Herrgott does not appear to be quite willing to admit the cases of spondyl-olisthesis developed on the basis of congenital spondylolysis, *vide l. c.*, p. 329: "We do not think it necessary to mention (in the list of spondyl-olisthetic pelves given by Herrgott) either the pelvis of the Hottentot Venus or the pelvis at Bonn, the documents about which do not appear to us to be sufficiently accurate." But since this mode of origin is proved in the cases of olisthesis of damaged vertebræ at Breslau and Berlin, and in the two pelves at Wurzburg, &c., the doubt as to the spondyl-olisthesis of the Hottentot Venus might well be abandoned.

In reference to the other cases referred by me exclusively to a

fracture of the arch of the fifth lumbar vertebra, or of the sacral articular processes, Herrgott attributes the development of the deformity not to this fracture, but to a loss of resistance in the lumbar vertebral arches due to inflammation.

On page 350, "It is evident that the vertebra must lose its normal resistance." "One cannot admit more than two possible causes of this effect; the arch supporting the articulations must be broken or softened—broken by some violent injury which would cause the displacement immediately, or softened by pathological action." "Since then," Herrgott continues, "the olisthesis does not occur suddenly but gradually during the long years duration of the disease," he decides for the latter mode of genesis, the rather so as "manifest traces of bony inflammation, osteophytes, osseous rarefaction (osteoporosis ?), loss of bone substance," are to be found, "everything to prove that a chronic inflammatory process has accompanied the evolution of the lesion."

On page 351 it is stated, "We were not, therefore, so far from the truth when we said that the same affection, of the nature of chronic inflammation (we said caries, which while incontestable for the body of the vertebra may be less exact for the arch), attacking two different parts of the vertebra may be the cause of two pelvic deformities essentially different.

Herrgott says in conclusion, p. 352, "We equally regret not to be able to admit completely the final conclusion of Neugebauer, which is thus stated, 'Spondyl-olisthesis is a surgical deformity, which is sometimes caused by an anomaly in the ossification of a vertebral arch, but which is more frequently caused by an injury.'"

The view of Neugebauer, it is said, moreover, "appears less satisfactory to us than the one which we have given, for it does not attribute to inflammatory action the important *rôle* that it appears to us belongs to it. If the injury was the efficient cause, the deformity would immediately follow it, which is not the case; a time, short or long, and most frequently very long, months, even years, pass away before the deformity is produced; the latter does not come on until the inflammation has accomplished its modifying action on the consistence of the vertebra, which becomes unequal to the maintenance of the continuity of the column."

I would to this reply as follows: in the first place, Herrgott

has now abandoned the Potts' disease he formerly insisted on, and refers the loss of resistance in the interarticular portion of the vertebral arch to "a chronic inflammatory state." Now then, by what has this state of chronic inflammation and giving way been called forth? Was it primary? Surely not. By what then was it caused? By a fracture, an injury? I refer the genesis of the olisthesis to this injury, without which the chronic inflammatory process of Herrgott would not have occurred, and consequently there would have been no olisthesis. Herrgott, on the other hand, refers the genesis to the condition of the vertebral arch that I assert is secondary, yet he himself says on pp. 350, 351: "This chronic inflammatory state of irritation is according to the history generally caused by an injury."

He quotes the statements from anamneses brought forward by me as examples, in regard to ascertained fractures and injuries and says, *es seien dies.*

"All traumatic actions the maximum result of which must affect the lumbo-sacral region."

"Is not the most frequent cause of chronic osseous inflammation to be found in these?"

"Once the inflammatory condition following injury is admitted the process becomes clear." Such a deformation of the bone as we see can only be produced if the bone has lost its resistance under the chronic influence, for then alone can it be extended and flattened out, and undergo such transformations under new statical conditions. "In one word, as origin of the lesion we look upon an injury which need not break the bone, it may be some other injury, but which inflames it, causes it to soften, and allows the entire metamorphosis to take place."

In the first place, it is not true that a fracture must cause the deformation to arise at once, that is to say, immediate dislocation. It may do so, but there is no must in the case. The dislocation after fracture is indeed very often only brought about by secondary influences, internal or external, muscular tension, overburdening during the process of union, or something of the kind, as soon as the force of the full blow or other injury has already been exhausted on the resistance of the bone Indeed the appearance (*eintritt*) of the dislocation of the fragment may be separated to a certain degree in time from the fracture; for example, dislocations and deformities often occur in consequence

of unsuitable bandaging apparatus, that would sometimes not happen had the repair been left to nature. And Herrgott says also (p. 352): "We much regret that we cannot completely agree with Neugebauer's final conclusion, which is thus stated: 'Spondyl-olisthesis is a surgical deformity, occasionally due to some anomaly in the ossification of a vertebral arch, but more frequently caused by an injury.'"

"Neugebauer's view," he states further on, "appears to us less satisfactory than our own, for he does not give to inflammatory action that important part in the matter which it appears to us to play. If the injury was the effective cause, the deformity would be an immediate result, and this is not the case; more or less time, and generally a very long time, consisting of months, or even years, elapses before the deformity, which does not arise until the consistence of the vertebra is so modified by inflammation that it is too feeble to support the rest of the spinal column, is produced."

In answer to this I would in the first place point out that Herrgott has now abandoned the causative action of Potts' disease he formerly insisted on, and attributes the loss of resistance in the interarticular portion of the vertebral arch to a "chronic inflammatory condition." But to what is this chronic inflammatory state and softening itself due? It cannot be a primary condition, but is itself due to some fracture or injury. While I look upon this injury, without which neither Herrgott's chronic inflammatory softening nor olisthesis could have occurred, as the origin of this olisthesis, Herrgott, on the other hand, refers the genesis of the olisthesis to a condition of the vertebral arch which I insist was secondary, and says, nevertheless, on pp. 350, 351, "This chronic inflammatory state of irritation is according to the anamuesis generally due to an injury."

He enumerates all the fractures and injuries mentioned in the anamuesis of the several cases which I have set down, and then says, "The maximum effect of all of these injuries must result in the lumbo-sacral region." "Have we not here the most frequent cause of chronic inflammations of the bone?" "Once the inflammatory condition RESULTING FROM INJURY is admitted, the process becomes clear." "The deformation of the bone, such as we see, can only result if the bone has lost its resistance under some chronic influence, for only then could it be elongated,

flattened out, and under the altering statical conditions undergo such transformation; in one word, as the origin of the lesion, we look on an injury which does not break the bone (the lesion may be quite different), but which inflames it, softens it, and allows all that metamorphosis to take place."

Now it is not true that the deformation or dislocation must be an immediate result of the fracture. It might, but by no means must be so. Indeed many a dislocation occurring after fracture is secondary, due to internal or external influence, muscular tension, strain during the process of repair, or some similar cause, the power of the fall or blow, or whatever it may be, having exhausted itself on the resistance of the bone, or a dislocation of the broken fragments may not happen till some time after a fracture, and we know that dislocations and deformities which would perhaps not have occurred if the cure had been left to nature, are not infrequently caused by improper bandaging. So in olisthesis the injury, or fall, causes the fracture, and then the predisposition to olisthesis, due to the weight of the body, necessitates the deformity, or rather the deformation. That from the alteration in the statical conditions or deformation, as well as in consequence of the fracture, infraction, or other injury itself, a chronic inflammatory condition of the bones does arise, and plays a certain part in the olisthesis, is self-evident, and has never been denied. But this inflammatory condition is always secondary, and therefore is not the cause of the spondyl-olisthesis, but is only a process accompanying it, and is like it, a result of the injury; the spondyl-olisthesis itself is therefore due to the injury.

However, Herrgott himself says this chronic inflammatory condition, put forward as the controlling cause, is a result of the injury.

The difference, therefore, between Herrgott's view and my own is only that he looks upon a chronic inflammatory condition of the vertebra, itself due to an injury, as that primary cause, which I find in the injury itself, for without the latter that "primary" chronic inflammatory condition would never have existed. It is essentially a difference in words only, for Herrgott, with whom I had an opportunity of conferring personally in Nancy not long ago about it, explained to me that in distinguishing between spondylizema and spondyl-olisthesis he had not intended to insist

that both affections were due to the same specific process, *i.e.*, to Potts' disease, but rather to indicate that spondylizema was a result of a softening or dissolution of the body of the vertebra, and was therefore due to disease of the body of the vertebra, while spondyl-olisthesis was a result of disease (=*ramollissement*, softening) of the arch of the vertebra, even if this disease was itself due to an injury.

At Friburg, towards the end of September, I received from Professor Frankenhäuser, to whom I would here express my thanks for his prompt courtesy, the Zurich pelvis for examination. In one half of the specimen I softened off the ligaments, and separated the fourth lumbar vertebra *in toto* from the fifth, so as to expose the *corpus delicti*, the fifth vertebral arch, and I removed as far as was necessary and possible the irregular attachments from both halves of the preparation. I found unmistakable traces of a fracture, which I had previously suspected *a priori*, on either side of the interarticular portion of the fifth arch. The conditions were very similar to those found in Olshausen's pelvis at Halle, in that at Liège, and to those in the B pelvis at Prague, in particular.

Without any detailed description of this interesting and fatal Zurich pelvis, I may illustrate the condition of the affected parts, *i.e.*, of the lumbo-sacral symphysis, by a few drawings. The olisthesis had, as is known, reached the stage of spondyloptosis; the body of the fifth lumbar vertebra lay well within the true pelvis, while the posterior part of its arch, and its isolated and extremely prominent spine, remained in the normal position; the body of the first sacral vertebra has been forced like a wedge into the lumen of the vertebral canal of the last lumbar vertebra, with proportionate enlargement of this lumen from behind forwards, and it is therefore quite evident that the interarticular portions of the arch of the last lumbar vertebra must be lengthened to the same extent that the body has been separated from the posterior transverse part of the arch. In fig. 20 the fifth lumbar vertebra is exposed by taking away the upper part of the vertebral column, and shows such an extension has really taken place. The arch is extremely elongated from behind forwards, the superior or anterior articular process (*a*) has in fact been separated to the extent of several centimeters from the inferior or posterior articular process (*b*), corresponding with the olis-

thesis of the anterior half of the vertebra. The length of the superior or anterior articular process (*a*) is greatly increased, and a corresponding flattening out and secondary deformation (from pressure) of the inferior articular process of the fourth lumbar vertebra may be seen in fig. 21. On comparing fig. 20 with the corresponding pictures of the specimens at Liège and Halle (see Neugebauer, *Archiv für Gynäkologie*, Bd. xx., Hft. 1, fig 29 and fig. 11), we see that the condition of the parts is

Fig. 20.

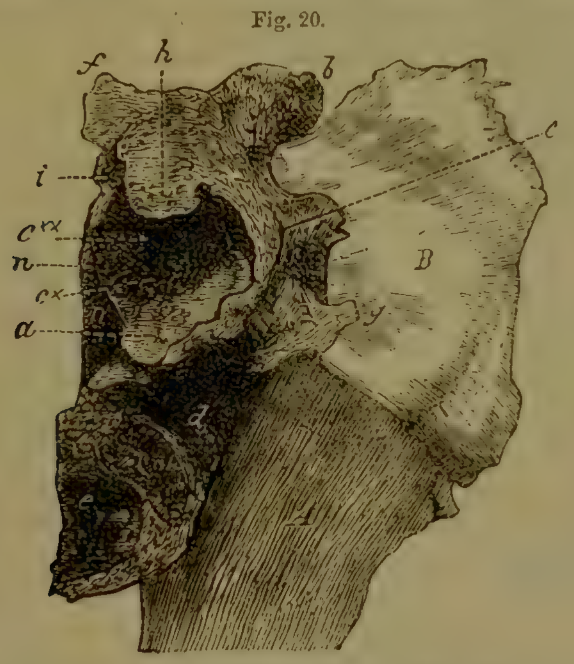



Fig. 20.—Left half of the sacrum and fifth lumbar vertebra of the Zurich spondyl-olisthetic pelvis as seen from above (from a photograph).

*A* sacrum.
*B* Mana lateralis ossis sacri sinistea.
*a* Superior articular process.
*b* Inferior articular processes.
*c* Interarticular portio of the arch.
*d* Neck.
*e* Body.
*f* Spine.
*g* Transverse process.
*h & i* Osteophytes projecting from the fifth lumbar vertebra.
$c^x$ $c^{xx}$ Portions of the superior articular process (*a*) and interarticular portion (*c*) wasted under pressure.
*nn* Exposed upper surface of the first sacral vertebra.

exactly similar. Indeed a special description of this Zurich case seems almost superfluous.

In fig. 21 we see that the interarticular portion of the fifth arch has nearly or quite disappeared. Under pressure and tension the wasting and elongation have gone so far that the

lower articular process of the fourth lumbar vertebra and the posterior transverse part of its arch are situated in direct contact with the lateral parts of the first sacral vertebra, so that the body of the latter is driven so far into the sacral aperture of the fifth lumbar vertebra, that it has forced the two segments of this vertebra quite apart, dislocating the anterior segment completely forwards, and interposing itself entirely between them.

The fourth lumbar vertebra lies therefore directly upon the first sacral vertebra, in the interval between the anterior (dislocated) and posterior (stationary) fragments of the fifth lumbar vertebra.

In fig. 22, which represents the same parts *in situ*, one can easily make out the anterior and posterior segments of the arch of the fifth lumbar vertebra, and observe the direct contact between the first sacral vertebra and the fourth lumbar vertebral arch, at the previous situation of the interarticular portion of the arch of the fifth lumbar vertebra.

The fifth lumbar vertebra of the Zurich pelvis is a typical instance of Lambl's dolicho-hyrto-platyspondylus, and its shape gives evidence of the gradual origin of the deformity.

Now what was the origin of the process in this case? Since the continuity of the arch of the fifth lumbar vertebra is not absolutely destroyed on both sides we may exclude the idea of any congenital lateral fissure in the vertebral arch, nor is there any indication of a primary fracture of the sacral articular process. We can therefore only suppose a primary fracture or infraction of the interarticular portions of the arch of the fifth lumbar vertebra. As a matter of fact the arch shows the traces of such an infraction, *i.e.*, dislocation of the fragments, diffuse callus, wasting from pressure, osteophytes, and marks of that insidious process of secondary inflammation.

But one cannot say from the preparation whether there may not have been in this case a secondary infraction of the arch after it had been extremely elongated and compressed under excessive pressure and tension bent into an acute angle, and atrophied that secondary infraction in which the sudden transition takes place from the last stage but one of the deformity into the last, into complete spondyloptosis.

Considering the tens of years that have passed since the commencement of the disease, it can easily be understood that

Fig. 21.

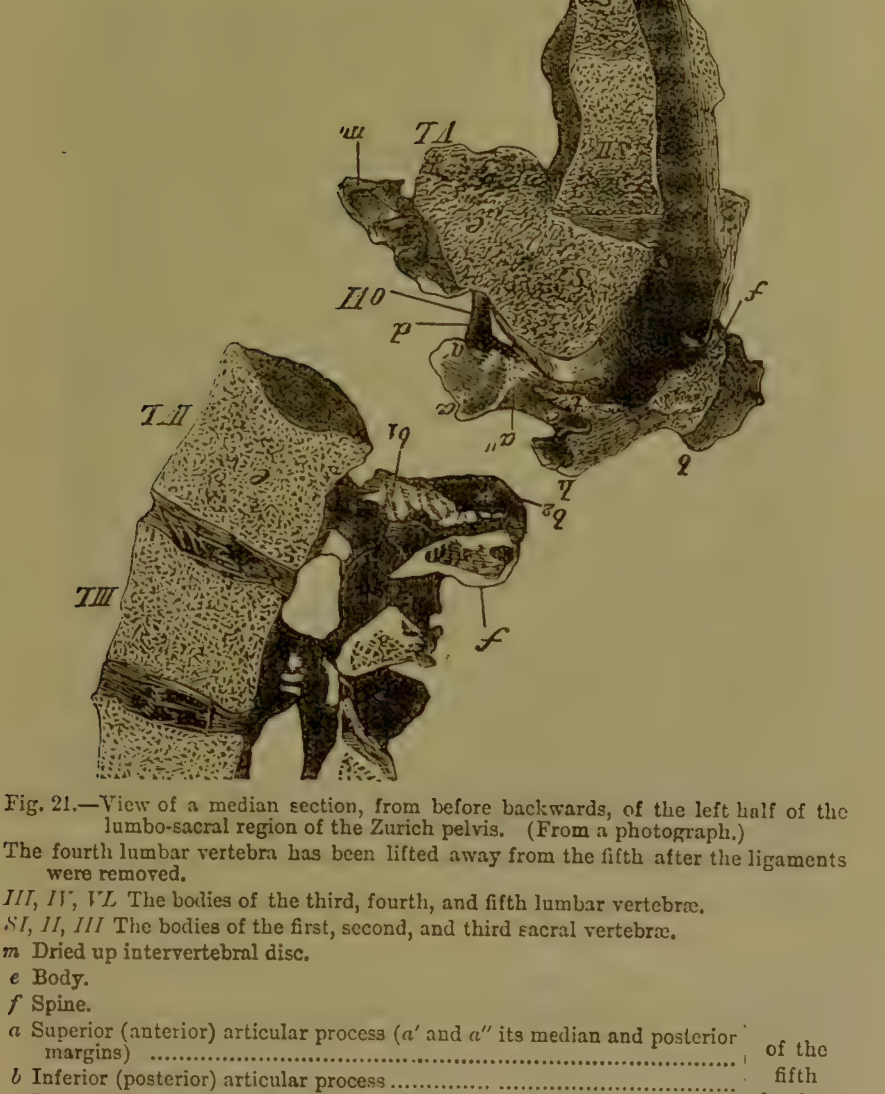


Fig. 21.—View of a median section, from before backwards, of the left half of the lumbo-sacral region of the Zurich pelvis. (From a photograph.)

The fourth lumbar vertebra has been lifted away from the fifth after the ligaments were removed.

*III*, *IV*, *VL* The bodies of the third, fourth, and fifth lumbar vertebræ.

*SI*, *II*, *III* The bodies of the first, second, and third sacral vertebræ.

*m* Dried up intervertebral disc.

*e* Body.

*f* Spine.

| | |
|---|---|
| *a* Superior (anterior) articular process (*a′* and *a″* its median and posterior margins) | of the fifth lumbar vertebra. |
| *b* Inferior (posterior) articular process | |
| *e* Interarticular portion of the arch (wasted *ad maximum* under pressure) | |
| *d* Pedicle | |

$b_1$ The articular surface of the inferior articular process of the fourth lumbar vertebra, changed in form and extended in length and breadth by pressure, *f* Fourth lumbar spine. $b_2$ Posterior part of the inferior articular process (*b*), and under surface of the posterior transverse portion of its arch; the latter, since resting on the anterior half of the last vertebra it has slipped forward with it, is lying almost directly on the lateral part of the first sacral vertebra.

*h* Part of the ligamentary attachments which united the fourth and fifth lumbar vertebræ, hardened like an osteophyte; this arising from the fifth arch, surrounds, like a claw, the arch of the fourth lumbar vertebra, which is gradually slipping out of it.

*i* A tooth-shaped, rudimentary relic of the former interarticular portion of the fifth arch, or a ligamentary mass hardened by ossification.

all traces of primary and of secondary deformation are only too completely confused or blotted out. The question therefore whether there was or was not a primary infraction in the arch of the fifth lumbar vertebra of the Zurich pelvis must remain open for the present. Such probably is the etiology of the case, but it can only be proved in the course of time by a process of exclusion.

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Of the 17 specimens of spondyl-olisthetic pelvis known to exist I have had at one time or another an opportunity of examining 10, namely, the two at Prague, Olshausen's case at Halle, that at Breslau, the Prague-Wurzburg case, the second Wurzburg case I have now recorded, that at Munich, those at Paderborn (?) and Zurich, the pelvis of the Hottentot Venus, and besides these ten the two specimens of olisthesis in the penultimate lumbar vertebra lately described at Berlin and Breslau. In reference to the other seven cases the Halle-Giesener one of Blasius appears to be lost, and in this case, as well as in that of the pelvis at Treves, I decidedly doubt the accuracy of the pathological-anatomical diagnosis between spondyl-olisthesis and caries. As to the remaining six pelves, I must confine myself to a consideration of the verbal descriptions which have been given of them, and of the pictures.

My investigations at present have led me to take the following view of the etiology of the so-called spondyl-olisthesis:—

(1) A Congenital Spondyl-olisthesis Interarticularis may exist in the Arch of the Fifth Lumbar Vertebra on one or both sides.*

This mode of origin is certainly indicated anatomically in several cases of the class; for example, in those at Paris and

* In reference to spondyl-olisthesis interarticularis congenita, I would now add to the 59 cases enumerated in my last work (*Archiv für Gynäk.*, Bd. xxi, Heft 2) some new cases that I have met with in Friburg, Basle, Strasburg, and Paris.

No. 60.—Bilateral of the fifth lumbar vertebra, number 0.11.6 of the Friburg Anatomical Museum.

No. 61.—Bilateral of the fifth lumbar vertebra, with separation of the posterior part of the arch into two lateral arches through the spine (*ibidem*).

No. 62.—Bilateral of the fifth lumbar vertebra, unnumbered, in a vertebral column with six sacral and five lumbar vertebra (*ibidem*).



Fig. 22.

Fig. 22.—Internal view of the left half of the lumbar sacral parts of the Zurich pelvis, from a median section (from before backwards) by a saw.

*III*, *IV*, *V*, Bodies of third, fourth, and fifth lumbar vetebræ.

*oIII*, *oIV*, *oV*, and *oVI*, The corresponding intervertebral foramina.

*o* First anterior sacral foramen.

*ff* Fourth and fifth lumbar spines the former has slipped forwards, so that the latter forms a solitary projection (compare Fr. Billeter, "Ein neuer Fall von hochgradiger Spondyl-olisthesis des Beckens." *Mang. Diss.*, Zurich, 1862. Tafel III.).

*a* Superior articular process } of the fifth lumbar vertebra.
*b* Inferior " " }

*b′* Inferior articular process of the fourth lumbar vertebra.

*n* Exposed upper surface of the body of the first sacral vertebra.

Isolated spikes of bone (compare *i* in figs. 20 and 21).

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No. 63.—Indicated spondyl-olisthesis interarticularis on the right arch of the second lumbar vertebra in the spinal column of a child two or three years old [specimen in spirit] (*ibidem*).

No. 64.—Bilateral of the fifth lumbar vertebra of a female pelvis in the Obstetrical Collection at Basle (from a woman with a funnel-shaped pelvis, who, a primipara 42 years of age, after the delivery with perforation of the head of the child, died on 7th February, 1880). (See Journal, No. 68, 1880.)

No. 65.—Bilateral of a lumbar vertebra.

Bonn, the Prague-Wurzburg pelvis, the second Wurzburg pelvis, and in the two specimens of olisthesis of the penultimate lumbar vertebra, and possibly in the B pelvis at Prague.

Fig. 23.




Fig. 23.—Spondyl-olisthesis interarticularis congenita, on the left side of a lumbar vertebra (Strasburg Anatomical Museum, 1880, No. 106). (Compare with the picture Neugebauer, *Archiv. für Gynäk.*, Bd. xx., Heft 1, fig. 16.)

A decision cannot be made, though it would be then a certain one, until consent has been given for separating the fourth lumbar vertebra from the fifth, as I have personally convinced myself may be done without injuring the specimen.

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No. 66.—Unilateral (right) of a lumbar vertebra, apparently of the same person (Anatomical Museum at Basle).

No. 67.—Bilateral of the last vertebra of a lumbar column of four vertebræ only (*ibidem*).

No. 68 and 69.—Bilateral of the fourth and fifth lumbar vertebræ, under No. 0. iii. 8, Museum of Pathological Anatomy at Friburg.

No. 70.—Bilateral of a lumbar vertebra under No. 62, 1881 (Anatomical Museum at Strasburg).

No. 71.—Unilateral on the left side, under No. 106, 1880 (*ibidem*), but without bipartition of the spine and middle posterior part of the arch (see fig. 23).

Nos. 72 and 73.—Bilateral of the fourth and fifth lumbar vertebræ in a male, under No. 0. iii. 8, in the Anatomical Museum at Strasburg.

No. 74.—Unilateral on the right side of the fourth dorsal vertebra of the abnormally and perversely ossified special column of a fœtus with sacral spina bifida, hydrocephalus, &c. (*ibidem*).

(Besides these specimens, I found in the Friburg Pathological Museum another fracture of the portio interarticularis of the second lumbar vertebra from a gunshot wound. The body of the vertebra was bisected in the median line, besides which the left half was divided transversely; the whole of the posterior part of the arch was also split off from its spine, so that the vertebra appeared cut into four pieces.)

Finally, I have lately obtained several specimens of spondylolysis, in which the condition varies considerably from the ordinary one.

No. 75.—Bilateral spondylolysis interarticularis congenita in a female pelvis, from the anatomical collection of Professor Farabœuf of Paris. This pelvis exhibits also a complete ossification of the left sacro-iliac ligament.

No. 76.—Fifth cervical vertebra of an adult (see fig. 24); on the left side, close behind the margin of the superior articular process, the arch is traversed by a congenital dividing fissure which gapes to the extent of 1—2 mm., and which divides the surface of the inferior articular process, or so to speak the inferior articular surface, into two parts, an anterior and a posterior segment.

There is therefore a spondylolysis interarticularis only in this case; the inferior articular process is also divided. This variation may perhaps be caused by some anomaly in the ossification of the vertebra. This case calls to mind the one described

I had this day, while visiting the collection in the Jardin des

Fig. 24.

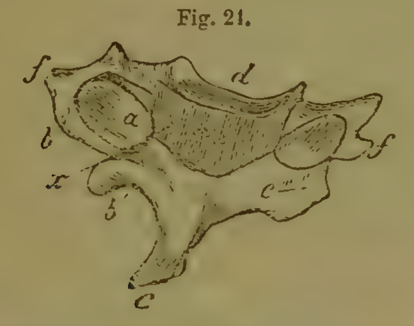



Fig. 24.—Fifth cervical vertebra with a congenital spondylolysis lateralis sinistra of the arch.

| | | |
|---|---|---|
| *a* | Posterior articular process | of the fifth cervical vertebra. |
| *b* | Inferior " " | |
| *b'* | Posterior portion of the articular surface of the inferior articular process | |
| *c* | Spine | |
| *d* | Body | |
| *e* | Interarticular portion | |
| *f* | Transverse process | |
| *x* | Spondylolysis | |

Plantes in Paris, the opportunity of personally examining the

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by Gruber (see Neugebauer, *Archiv für Gynäkologie*, Bd. xx., Heft 1, fig. 12), and the spondyloschizis lateralis sinistra of the Prague-Wurzburg pelvis.

Nos. 77 and 78.—Fourth and fifth lumbar vertebræ with an extremely peculiar and unique form of spondylolysis. Whereas in general the fissure traverses the portio interarticularis of the arch, and the spine itself is generally divided into two parts, in this case the posterior span of the arch in both vertebræ with the spine is perfectly developed, but the left inferior articular process of the fourth vertebra, and the left superior of the fifth, is formed of one single piece of bone. The condition of the surfaces of separation of the central parts and the external appearance are direct evidence of a congenital condition.

The peripheral parts of this specimen, that is to say, the two isolated articular processes, have unfortunately been destroyed. The fifth lumbar vertebra is depicted in fig. 25.

No. 79.—Fifth lumbar vertebra of a child about ten years old, in which the posterior half of the arch on the right side is an isolated piece of bone, united by ligamentary bands with the right interarticular portion, and with the pedicle of the spine on the left side.

No. 80.—Fifth lumbar vertebra, with bilateral congenital interarticular fissure. Many of the last preparations are derived from the private stores of the servants of different anatomical institutions, where so many interesting specimens, carelessly thrown aside, are destined to be worked up into some heterogeneous skeleton or other. I also found some specimens among the vertebra in the collections of the Parisian dealers in natural history specimens.

No. 81.—Bilateral interarticular spondyloschizis (the congenital nature of which cannot be absolutely insisted on, because of some unfortunate fractures) in one of the lumbar vertebra, which I found about three weeks ago during an inspection of the

skeleton of the Hottentot Venus, who died in Paris on 1st January, 1816, at the age of 38, and must agree completely with the opinions of Hennig and Lambl, that it is a case of spondyl-olisthesis, but that it would probably never have reached a higher degree if no further pregnancy had occurred to promote it. If the superior articular process on each side is placed perpendicularly above or immediately in front of the inferior, the separated halves of the vertebral arch cannot be placed in contact, but

Fig. 25.

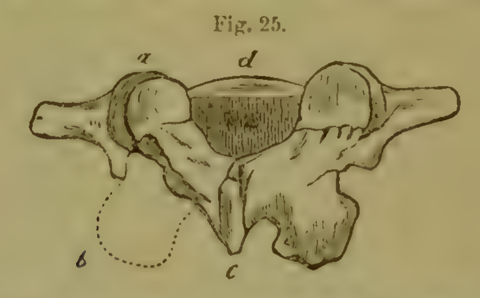



Fig. 25.—Fifth lumbar vertebra, with a defect in the ossification between the arch and left inferior articular process. The latter (*b*) forms in the specimen an isolated piece of bone.

stand somewhat apart. There is therefore some elongation of the interarticular portion, and the body of the fifth lumbar vertebra must during life have been displaced forwards, as is also proved to have been the case by the depression and grinding away of the anterior edge of the body of the first sacral vertebra, and the condition of the lumbar spines, which show there was a considerable lumbar lordosis with a corresponding position of the body of the fifth lumbar vertebra.

## (2) Fracture of the Articular Processes of the Sacrum.

This mode of origin also is absolutely proved anatomically by the specimen of spondyl-olisthesis lumbo-sacralis at Breslau,

bony treasures stored up in the Catacombs of Paris, in company with Dr. Bonnaire, Interne of the Paris Maternity, where so many interesting pathological specimens have been found.

No. 82.—Bilateral congenital spondyloschizis interarticularis vert. lumbalis, V., in the skeleton set up *à la Beauchêne* in the Museum of the Amphithéâtre des Hospiteaux in Paris.

In any case, the important series of 82 observations of these lateral fissures in the vertebra, which manifest such numerous variations, will help to develop the historical knowledge of the manner of ossification of the vertebra. Unfortunately up to the present time this question has been very imperfectly investigated, and it is desirable that some embryologist or histologist should undertake it, as an independent work.

described first by Strasser, and afterwards by myself, and was I believe the mode of origin in the Paderborn pelvis.

In these cases one may speak of a dislocation of the last lumbar vertebra as a whole, for as sure as the sacral articular processes are broken under the action of the body weight the fragments cracked off the arch of the fifth lumbar vertebra supported by them, and therefore the whole of the last lumbar vertebra slips a little forwards. But this movement soon ceases, for the fragments broken off the articular processes are arrested by the posterior edge of the upper surface of the body of the first sacral vertebra, and with this arrest the displacement of the fifth lumbar vertebra *in toto* is put an end to, and it is only the anterior half of this vertebra, as in the other cases, that now continues to slip forwards under the mechanical conditions of its present position.

### (3) Primary Lateral Fracture of the Arch of the Fifth Lumbar Vertebra.

This is anatomically evident in the Munich pelvis, and may be suspected in many other cases, probably was so in the B pelvis at Prague, unless this was a case of congenital spondyl-olisthesis. In reference to this, the third mode of origin, there are still many points to be discussed.

In the first place, it is certain that in many cases of complete spondyloptosis, the highest degree of olisthesis—and fortunately it is only such pelves for the most part which reach the museums in consequence of deaths in labour directly due to the spondyl-optosis—the fifth lumbar vertebra is closely united to the sacrum by synostosis, and their anatomical investigation is very difficult. The lumbo-sacral articulation must be most carefully examined for any fracture, especially for any fracture of the sacral articular processes such as that in the Breslau pelvis. Unfortunately this endeavour is generally unsuccessful, for these lumbo-sacral articular processes are for the most part completely united by synostosis, so that no fracture can be proved by appearances. The shape, that is the antero-posteror extension of the articular surfaces of the lumbo-sacral joint, always gives a certain amount of evidence, and where a primary fracture of the sacral articular processes has taken place, the lumbar articular processes seen

from above are abnormally elongated in proportion to the interval between the fragments. For example, in the Paderborn pelvis I believe that a primary fracture of the sacral articular processes has occurred, because the lumbar articular processes are drawn out to a most unusual length, so that the entire posterior transverse span of the arch of the fifth lumbar vertebra, in consequence of this elongation of its inferior articular processes, an elongation which, as already mentioned, corresponds to the degree of the interval between the fragments of the broken sacral articular processes, is moved somewhat forward. And as regards the pelvis at Halle and the A pelvis at Prague, I have already stated my belief that this primary fracture of the sacral articular processes, which unfortunately from the extensive synostosis in both cases is unsupported, except by the elongation of the inferior lumbar processes, was the mode of their origin. Be this as it may, there is still a very important question to decide. If a fracture or infraction in the interarticular portion of the arch of the fifth lumbar vertebra has evidently taken place in a pelvis, was this fracture or infraction, as the case may be, primary or secondary? The mode of origin of the secondary infraction, at the moment when elongation of the arch of the fifth lumbar vertebra having already reached a maximum, on the occasion of some sudden forcible strain, while the upper trunk is bent over forwards, the body of the fifth lumbar vertebra is tilted completely over, forwards and downwards, and passes out of the third stage of olisthesis of Lambl into the fourth stage, that of complete ptosis, is perfectly comprehensible, and my theory of it has not as yet been opposed. Now this question is a most difficult one. According to the principles of mechanics, secondary infraction is certainly more probable than primary. But whether the infraction is always secondary is a question that cannot be at present settled, the less so as there certainly are cases in which the spondyloptosis, the complete tilting over of the body of the fifth lumbar vertebra, takes place quite gradually without any infraction of the arch.

On the other hand, it is proved by several pathological anatomical preparations that a primary fracture of the interarticular portion of the vertebral arch does sometimes occur. Those cases, therefore, in which there has not been any congenital spondylolysis interarticularis, and no fracture of the sacral articular

processes can be pointed out, where in fact these processes are unaltered, nothing can be supposed except this questionable primary fracture of the arch of the fifth lumbar vertebra until we can find some other mode of origin of spondyl-olisthesis; and indeed this supposition seems to be the more justifiable, for *it is admitted that in by far the greater number of cases the anamnesis gives evidence that the spondyl-olisthesis commenced in a fracture.* If the entire posterior transverse span of the arch of the fifth lumbar vertebra is still in its normal place, that is, not displaced forwards, and if it is either not ossified on to the sacral articular processes, or if it be, if there is no elongation in the inferior lumbar articular processes from behind forwards, we may then suppose a primary fracture of the interarticular portion of the arch of the fifth lumbar vertebra (no congenital spondylolysis existing at this place); but if the entire posterior transverse span of the arch of the fifth lumbar vertebra has moved forwards with the rest, and if its inferior articular process exhibits an elongation from tensions corresponding with this forward movement, I think that the idea of a primary fracture in the sacral articular processes with separation of the fragments from each other is more justifiable.

Summarising what has been said, we may formulate the etiology of spondyl-olisthesis at the present time as follows—

Olisthesis may exist—

(1) On the ground of congenital lateral defect in the ossification of one or both sides of the arch of the fifth lumbar vertebra, especially in the interarticular portion of the arch (spondyloschizis interarticularis congenita arcus vertebralis).

(2) On the ground of a primary fracture—

(*a*) Of the sacral articular processes, if the posterior transverse span of the arch of the fifth lumbar vertebra is displaced forwards, and its inferior articular process exhibits a corresponding antero-posterior elongation.

(*b*) Of the interarticular portion of the arch of the fifth lumbar vertebra, if the posterior transverse span of the arch is not displaced forwards, but has remained in its normal position, and whether the lumbo-sacral joint is ankylosed or not.

It lies with anatomists and pathological anatomists, and with

those who make surgical and forensic post-mortems to look out for the early stages of spondyl-olisthesis in all fatal cases of injury from falling. If this is done, I am sure that before very long commencing or advanced spondyl-olisthesis lumbo-sacralis will be occasionally discovered during the examination of dead bodies at various places.

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